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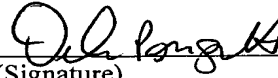
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NEW APPLICATION TRANSMITTAL FORM

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Transmitted herewith for filing is the patent application of

Inventor(s): **Hannu Kakkori**

For (title): **Adaptive Optical Plane Formation With Rolling Shutter.**

Enclosed are the following:

- ☒ Application Cover Page
- ☒ **28** pages of Specification that consists of, **20** pages of Description, **7** pages of Claims and **1** page of Abstract;
- ☒ **6** sheet of drawings;
- ☐ Inventor(s) Declaration;
- ☐ Preliminary Amendment;
- ☐ Priority is hereby claimed from:
 - Patent Application Number filed on ;
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 - Patent Application Number filed on ;
- ☐ Certified Copy of priority document(s);
- ☐ English language translation of priority document;
- ☐ Application Data Sheet;
- ☒ Information Disclosure Statement and/or Form PTO 1449 and cited non-U.S. art (if applicable);
- ☐ Assignment and Recordation Form Cover Sheet;
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- ☐ Other:

Assignment Data

- ☒ An assignment of the invention to Nokia Corporation
☐ is attached.
☒ will follow.
☐ has been previously filed.

Small Entity Status

- ☐ Applicant claims small entity status.

Fees

- ☒ Utility ☐ Reissue
☐ Design

Basic Filing Fee \$ 300.00

Excess Claim Fee

	Number Filed	Number Extra	Rate	
Total Claims	45 - 20 =	25 x	\$ 50.00	\$ 1250.00

Independent Claims	7 - 3 =	4 x	\$ 200.00	\$ 800.00
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☐ Multiple Dependent Claim Fee (\$360.00) \$

Examination Fee \$ 200.00

Patent Search Fee \$ 500.00

Exceeding of 100 sheets of paper fee (\$250.00 per each 50 sheets) \$

Assignment Recordal 0 x \$ 40.00 \$

TOTAL FEES \$ 3050.00


- ☒ A check in the amount of \$3050.00 in payment of the filing fee is enclosed.
- ☐ Charge \$ to Deposit Account No. 50-1924
- ☒ The Commissioner is hereby authorized to charge any additional fees under 37 C.F.R. 1.16 and 1.17 which may be required for this communication or during the entire pendency of this patent application, or credit any overpayment, to Deposit Account No. 50-1924.

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Nokia Corporation Docket No.: NC48724
Harrington & Smith, LLP Docket No.: 877.0006.U1(US)
Application for United States Letters Patent by:
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**ADAPTIVE OPTICAL PLANE FORMATION
WITH ROLLING SHUTTER**

ADAPTIVE OPTICAL PLANE FORMATION WITH ROLLING SHUTTER

TECHNICAL FIELD:

[0001] The present invention relates to methods and optical devices that provide an increased depth of field.

BACKGROUND:

[0002] Traditional photography relies on exposing a planar portion of the film through a fixed focusing lens (or lenses) so that an object of interest would be precisely focused on the film. The film is disposed perpendicular to an optical axis and located at an image distance s_i behind the lens that matches an object distance s_o at which the object is located in front of the lens. Especially in macro photography but to a lesser extent with all photography, other objects within the exposed scene but at a distance other than the image distance s_o are out of focus on the film. This basic concept prevalent throughout film photography continued as digital photography was introduced, using a pixilated array in place of the film.

[0003] Fig. 1 is a prior art schematic diagram showing a lens 20 focused on an object located at an infinite object distance, so that all light rays 22 incoming to the lens 20 are substantially parallel. The lens is assumed thin for certain assumptions. The focal length f of the lens 20 is that distance behind the lens where parallel light rays entering the lens are focused. The image distance s_i is that distance behind the lens 20 wherein light through the lens from a specific object distance s_o is focused. Since the object distance s_o in Fig. 1 is far (the light rays incoming to the lens 20 are substantially parallel), then $s_i=f$, the image distance is the lens focal length.. The sensor 24, which may be film, a digital pixilated surface, a sensing array, etc., is positioned at the image distance s_i so that the particular object imaged is in focus. This relation is described by the Gaussian (thin) lens formula: $\frac{1}{f} = \frac{1}{s_o} + \frac{1}{s_i}$. For an object located at an infinite distance, s_o is large and $\frac{1}{s_o}$

becomes vanishingly small, so $f \approx s_i$. Fig. 2A is similar to Fig. 1, but with the lens 20 moved so that an object at a distance $s_o \ll \infty$ (e.g., less than about 20') is instead focused on the sensor 24. The focal length f has not changed between Figs. 1 and 2A; it is set by

the shape and refractive index of the lens 20. Movement of the lens 20 or sensor 24 enables focusing of non-parallel incoming light rays 22 at the sensor 24, and the relation is represented mathematically as $s_i = \frac{s_0 f}{s_0 - f}$.

[0004] Fig. 2B is a photograph (such as one taken with the lens arrangement of Fig. 2A) of domino tiles disposed at various distances from the lens, and illustrates depth of field. The image shows three consecutive domino tiles 25, 26, 27, each having a horizontal line and three dots visible above that line. The middle of those three domino tiles 26 is located at the distance s_0 of Fig. 2A, and is therefore in sharp focus on the sensor that we view as Fig. 2B. The remaining two 25, 27 of those three domino tiles are in acceptable focus, and are located at respective distances $s_0 - x$ and $s_0 + x$, assuming all domino tiles are equally spaced from one another by a distance x . All other domino tiles are blurred, as they are located more than the distance x from s_0 . Critical or precise focus may be achieved at only one distance s_0 from the lens 20. In Figs. 1-2B, this distance is the object distance s_0 .

[0005] As is evident in Fig. 2B, there is a range of distances ($s_0 \pm x$) for which focus is acceptably sharp. This zone of acceptable focus is termed depth of field. More technically, the depth of field is the region where the size of the circle of confusion is less than the resolution of the human eye. The circle of confusion is a term well known in the optical and photographic arts, and relates to the fuzziest a point can be and still be considered "in focus". Increasing depth of field has been the subject of certain improvements to the arrangements of Figs. 1 and 2A.

[0006] One such prior art arrangement to increase depth of field is shown schematically at Fig. 3. In this arrangement, the sensor 24 defines a surface that is tilted and no longer perpendicular to the optical axis 26 defined by the lens 20. An object located nearer the top of Fig. 3 is at a distance s_{01} from the lens 20. Light rays 22a incoming to the lens 20 are not parallel, is focused precisely at a portion of the sensor 24 at a distance s_{11} behind the lens 20. Within the same scene and within the same exposure of the sensor is a second object, located nearer the bottom of Fig. 3 and at a distance s_{0inf} from the lens 20. Light rays 22b from this second object are substantially parallel when

they enter the lens 20, and are focused precisely on a portion of the sensor 24 that is at a distance s_{iinf} behind the lens 20. Because s_{il} is not equal to s_{iinf} , depth of field is increased, i.e. the position of the best focus shifts when moving from the top of Fig. 3 towards the bottom of Fig. 3. The arrangement of Fig. 3 is implemented commercially in the Canon[®] TS-E 24 mm lens of Fig. 4 allowing to better image objects or scenes which appear “tilted” respect to the camera device. This effect is achieved by arranging a tilt angle between the imaging lens(es) and the sensor plane either by tilting the lens(es) alone or by tilting the sensor itself, as described below.

[0007] Another prior art arrangement is described in US Pat. No. 6,783,068, entitled “Large Depth of Field Line Scan Camera”. In this adaptation, a scanning system utilizes a randomly addressable image sensor, which is selectively positioned at the Scheimpflug angle in the image plane in order to detect focused light reflected from an object. Light reflected from the object is focused onto the sensor through an objective lens. Since the sensor is mounted at the Scheimpflug angle, each strip within the depth of field of the object plane has corresponding pixels on the sensor that are in focus.

[0008] US Pat. No. 6,567,126 is entitled “Planar Focus Correction” and describes a camera that includes a detector array and an objective lens arranged to direct optical radiation from an object plane onto the detector. The lens defines an optical axis of the camera, and the object plane is at an oblique angle. An optical axis movement device changes the relative orientation of the detector with respect to the lens so that the detector and lens may be moved relatively toward or away from each other along the optical axis and also tilted with respect to each other with at least one degree of freedom. This enables a focus detection device, connected to the detector, to detect when a portion of an image falling on the detector is in focus, holding an in-focus portion of the image in focus until a second portion also comes into focus.

[0009] US Pat. No. 6,445,415 is entitled “Increased Depth of Field for Photography” and is described as primarily for electronic cameras. An image is created electronically from a sensor in the camera and is based on a multi photo technique. Several photos are shot with different focused parts of the scene subjects in the respective photo, and a basic image is integrated by contributions from the different images. Calculated image transfers are based on lens- or sensor settings for the respective images.

[0010] US Pat. No. 5,282,045 is entitled "Depth of Field Control Apparatus and Image Pickup Apparatus Having the Same Therein". In this patent, image signals corresponding to a plurality of picture images different in focal point or length position are obtained by a mechanism for changing a focal point or length position to produce a new image signal by composing these image signals through a composition circuit. Motion information of an object is obtained by a circuit for detecting a moving portion in the object to control the image composition by the motion information. The focal point or length position is moved in synchronism with an integer multiple of a vertical scanning period of the television. The image signals corresponding to the plurality of picture images, different in focal point or length position, are obtained within one vertical scanning period determined by the system of the television. The amount of movement of the focal point or length position is controlled in conjunction with a value of a lens aperture of the camera lens. The image composition is controlled by a composition control circuit made up of a circuit for detecting individual powers of image signals corresponding to a plurality of different picture images, a circuit for comparing the detected powers with each other, and a circuit for detecting the position of an edge included in one of the image signals. A control signal for the image composition produced by the power comparison circuit is compensated by the edge position information obtained by the edge detection circuit.

[0011] While interesting, each of the above prior art descriptions appear to overlay different planar images of objects within a scene to arrive at a composite having a higher depth of field as compared to any of the individual planar images. However, optical lenses are known to define a Petzval surface or Petzval field curvature as shown in Fig. 5. Briefly, a Petzval surface is a paraboloidal surface at which objects lying along a plane that is perpendicular to the optical axis are precisely focused on the opposed side of the lens 20. Assume a fixed distance of s_0 in Fig. 5. Objects at the distance s_0 from the optical center 32 in front of the lens 20 are along the curved surface δ_0 , and absent aberrations are focused precisely at the curved surface 28 behind the lens 20 as defined by the image distance s_i . These curves δ_0 and 28 are typically spherical, but their shape depends upon the lens curvature. Now, flatten the curve δ_0 to a plane that is perpendicular to the optical

axis 26 at a distance s_0 , yielding the object plane δ_0' . For imaging the scene at the object plane δ_0' at the planar sensor 24, this imposes an additional aberration, because objects along the object plane δ_0' are now precisely focused along the Petzval surface 30, which further diverges from the (spherical) surface 28. It is stipulated that divergence between the planar and curved surfaces of Fig. 5 are exaggerated for clarity of illustration. The planar sensor 24 now images two orders of aberrations, the first due to its non-coincidence with the (spherical) surface 28 defined by the distance s_i , and the second due to its non-coincidence with the (paraboloidal) Petzval surface 30. The image is focused precisely only at the optical axis, where the sensor 24 is tangent to and co-incident with both curved surfaces 28, 30. Objects imaged off the optical axis are increasingly out of focus. These aberrations are due to field curvature. Using the example of Fig 2B, the best-focused domino tile 26 may be precisely focused only at the horizontal line of that tile because that line is located along the optical axis, while the top and bottom of that same tile 26 are out of focus due to field curvature, though not particularly noticeable in Fig. 2B. None of the above prior art solutions for increasing depth-of-field are seen to offset field curvature, in either the first or second order. Whereas a four-lens arrangement known in the art may minimize or even eliminate the field curvature illustrated by Fig. 5, such arrangements yield a shallow depth of field, because the object distance at which precise focus is obtained is merely shifted from a curved to a planar surface without additional optical aberration, yet precise focus still lies at only one distance from the lens 20.

SUMMARY:

[0012] The foregoing and other problems are overcome, and other advantages are realized, in accordance with the presently detailed embodiments of these teachings.

[0013] According to one embodiment, the invention is a method for imaging a scene. The method includes manipulating an optical relationship between an optical lens and an image sensing surface, and exposing different portions of the image sensing surface synchronous with manipulating the optical relationship. The optical relationship is manipulated so that the image sensing surface is spaced at different effective image distances from the lens. The synchronous actions may be adaptive to objects in the scene

being imaged, such as distance of objects from the lens, brightness of objects to vary exposure time of the different portions, and/or speed of object movement to vary exposure time of the different portions. Exposing different portions of the sensing surface includes a traditional film and shutter arrangement, voltage integration of pixels on a digital sensing surface, as well as other imaging techniques.

[0014] According to another embodiment, the invention is another method for imaging a scene. This other method includes determining a first and a second object distance between a lens and respective first and second objects in a scene. Within a continuous exposure frame, a first portion of an image sensing surface is exposed while the image sensing surface is at a first effective image distance from the lens, and a second portion of the image sensing surface is exposed while the image sensing surface is at a second effective image distance from the lens. The first and second effective image distances correspond to the first and second object distances, generally in a known way according to optical characteristics of the lens itself. The exposed first and second portions are then combined into a single image.

[0015] According to another embodiment, the invention is a camera that includes a lens, an image sensor such as photographic film or an array of photo-sensitive pixels that form a sensing surface. The camera also includes exposure means for separately exposing different portions of the sensing surface within a single exposure frame. The exposure means may be a curtain-based rolling shutter or it may be integrating/exposing pixels (or groups or rows of pixels) over different time periods within the exposure frame. The camera also includes means for manipulating an optical relationship between the lens and the sensing surface so that the sensing surface lies at an image distance that changes. The means for manipulating may comprise mechanical linkage to move the lens and sensing surface relative to one another, or a voltage source with leads to apply a voltage to a liquid lens, thereby changing its shape and effective image distance. The camera includes a processor for synchronizing the means for manipulating with the exposure means.

[0016] According to another embodiment, the present invention is a device that includes a device housing, as well as a lens, an image sensor, exposure means and a processor as immediately above. The light passing through the lens also enters the housing, and the device may be a mobile station. This device has an optical manipulation

means for maintaining the image sensor at an effective image distance from the lens that varies over the single exposure frame.

[0017] According to another embodiment, the invention is a program of machine-readable instructions, tangibly embodied on an information bearing medium and executable by a digital data processor, to perform actions directed toward operating a camera. The actions include, during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface. In some embodiments, either or both of maintaining the image sensing surface at the variable effective image distance and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface, such as their distance from the lens, their brightness, their speed of movement, or other parameters.

[0018] According to another embodiment, the invention is an apparatus for adaptively imaging a scene. The apparatus includes means for focusing light from a scene, means for imaging the focused light such as film or a pixilated array, means for determining a first and a second object distance, means for differentially exposing selectable portions of the sensing surface to light passing through the means for focusing, means for varying an effective image distance between the means for focusing light and the means for imaging, and means for synchronizing the means for varying with the means for differentially exposing.

[0019] According to yet another embodiment, the present invention is a method of imaging a scene. This method includes imposing on a sensing surface an effective optical curvature that depends from a scene, and imaging the scene at the sensing surface having the effective optical curvature. That the curvature is effective means that it need not be embodied in a spatial sense.

[0020] Other various aspects, embodiments, and adaptations of the invention are disclosed in detail below.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0021] The foregoing and other aspects of these teachings are made more evident in the following Detailed Description, when read in conjunction with the attached Drawing Figures, wherein:

[0022] Fig. 1 is a prior art schematic diagram showing focusing of an object at a large object distance where incoming light rays may be considered as being parallel to one another.

[0023] Fig. 2A is a prior art schematic diagram showing focusing of an object at a shorter distance where incoming light rays are not parallel.

[0024] Fig. 2B is an image of domino tiles at different object distances, illustrating depth of field.

[0025] Fig. 3 is a prior art schematic diagram showing a sensor surface inclined relative to the optical axis defined by the lens.

[0026] Fig. 4 is a prior art image of a commercial product incorporating the concept of Fig. 3.

[0027] Fig. 5 is a prior art schematic diagram illustrating off-axis aberrations and a Petzval surface.

[0028] Fig. 6 is a schematic diagram showing a lens and sensor that illustrate the optical effect of an embodiment of the present invention.

[0029] Fig. 7 is a schematic diagram showing a moveable lens and sensor according to an embodiment, which results in the optical effect of Fig. 6.

[0030] Fig. 8 is a schematic diagram showing the concept of a rolling shutter for exposing different rows of a sensor according to a first lens movement.

[0031] Fig. 9 is similar to Fig. 8 but for a second lens movement.

[0032] Fig. 10A is a scene showing objects at four different object distances.

[0033] Fig. 10B is a sensor surface with outlines of the objects of Fig. 10A, illustrating scene adaptive pixel exposure as a focusing lens translates.

[0034] Fig. 11 is a schematic block diagram showing a camera according to the present invention disposed within a mobile station.

DETAILED DESCRIPTION:

[0035] The present invention incorporates in certain embodiments a rolling shutter. A focal plane shutter of a traditional 35 mm SLR camera creates a slit of variable width by using two curtains that travel in front of the photographic film. While the rate of the travel is fixed, exposure time is varied by changing the time that elapses between the release of the first shutter curtain and the release of the second shutter curtain. When the camera takes a photograph, the shutter is opened as follows: the first curtain is released, and at some later time (the exposure time), the second curtain is released. The width of the slit determines the total time any part of the film is exposed.

[0036] Digital photography uses an array of pixels (e.g., photodiodes) along the sensor surface, which are pre-charged to a known voltage prior to “exposure” of the sensor, which is technically the integration period of the individual pixels. The pixels are removed from the source of the pre-charge at the start of the integration period, when the actuator for the digital camera is depressed. Once the source of the pre-charge is disconnected from the pixels, each pixel leaks charge as a function of light (photons) striking that particular pixel. The remaining charge at the end of the integration period (typically at readout of the pixels) is inversely proportional to the light to which the pixel was exposed. The remaining charge on each pixel is electronically read out and spatially combined with other pixels of the array to construct the digital image.

[0037] The concept of rolling shutters in digital photography is then removing the pre-charge from a particular group of pixels, but not from all pixels in the array. Similarly to the rolling shutter of film photography, the pre-charge may be disconnected from different horizontal lines of pixels

ion a sequential manner. Each line of pixels then has an integration period that is less than the scan period for the entire array; exposure of the pixels 'rolls' among the lines. Disconnecting the pre-charge from a line is analogous to releasing the first curtain of a 35 mm SLR camera, and readout (which ends the integration period) is analogous to releasing the second curtain. The term rolling shutter is used herein to refer to both film and digital embodiments. Clearly then, exposing different portions of an image sensing surface (to light through a lens), as used herein and in the claims, can be arranged by using a separate shutter external to the image sensor (e.g., traditional film photography), or without any external shutter using a sensor having internal (e.g., a readout integrated circuit) electronic rolling shutter capability, i.e., a sensor where the exposure of the pixels is defined electronically by how they are read out, for example line by line. Because in digital photography there is no physical curtain but rather a circuit-based switch between each pixel and the pre-charge source (and also between the pixel and readout circuitry), digital cameras are not restricted to rolling shutters that are line-based as in the above example, but can vary exposure/integration time among individual or distinct groups of pixels even where the pixels or groups are not contiguous for sequential exposure times.

[0038] To appreciate the statement immediately above, consider a scene with a first and second object in a foreground, each at a fixed object distance s_{01} and s_{02} from the lens, and a background at an object distance $s_{03}=\infty$ from the same lens. Assume the first object is in motion, so a shorter exposure time is desirable to maintain focus. Neither the second object nor the background is in motion, so a longer exposure time enhances photo quality due to more photons striking the pixels over the increased integration time. Longer exposure times are particularly valuable in low light conditions, or when an object is dark as compared to a bright background or vice versa. Light from the first object and passing through the lens falls primarily on a first set of pixels, and from the second object and the background fall primarily on a second and third set of pixels, respectively. To 'roll' exposure for the best combination of focus and resolution, pre-charge may be disconnected from the second and third sets of pixels, then at a later time disconnected from the first set, so that exposure/integration is begun at a different time for the first set as compared to the second and third sets. Reading out all pixel sets at the same time varies the integration period as between the first versus the second and third sets. Similarly,

exposure time may be initiated at the same time for all three sets of pixels and terminated (by readout) at different times.

[0039] The integration period may be adaptive to the objects themselves (their speed of movement, their distance from the lens, etc.). The first object is imaged with a short exposure time/integration period and the second object and background are imaged with a longer integration time (movement adaptive). Where movement is not electronically sensed at the camera, the first and second sets of pixels may be integrated over a shorter time as compared to the third set, and the integration time for each set may be dependent upon distance from the lens (most digital cameras use auto focus). In the latter instance (distance adaptive), the first and second sets of pixels need not be contiguous along the sensor surface in order to 'roll' exposure, and the integrating periods for the first and second sets of pixels may be the same or different from one another (if $s_{01}=s_{02}$).

[0040] However, rolling exposure alone neither enhances depth of field nor corrects field curvature. To correct for field curvature (see Fig. 5), prior art solutions generally either use field flattening lens arrangements (typically four lenses, three positive and one negative), or curve the exposed film or sensor surface to more closely match the surfaces 28, 30 of Fig. 5. The present invention considers a different way to enhance depth of field and correct field curvature that incorporates the rolling shutter as above, in either film or digital manifestations.

[0041] Consider Fig. 6, a schematic view of a lens and sensor arrangement that shows the optical *effect* produced by an embodiment of the present invention. The scene 36 is shown at the right of Fig. 6 as viewed through the lens 38. In profile view, it is clear that the scene 36 is a flat plate angled with respect to the optical axis so that a first horizontal swath a_0 of the scene 36 is at a first object distance s_{0a} from the lens 38, a second horizontal swath b_0 of the scene 36 is at a second object distance s_{0b} , and all other swaths are at intermediate object distances between those two. Statically, precise focus through the lens 38 for each swath of the scene 36 occurs along the curved sensor surface 40a, which varies between a first image distance s_{ia} and a second image distance s_{ib} . The total distance between shortest and longest image distances is illustrated as the span d , and in Fig. 6 is that distance between nearest and furthest lines of the curved sensor surface

40a. However, the exact curvature of the sensor surface 40a and the exact span d may be made scene dependent by the present invention.

[0042] Fig. 7 illustrates the apparatus according to an embodiment of the present invention used to achieve the optical effect of Fig. 6. Rather than curve the sensor surface 40a (as in Fig. 6) in a manner that will produce the optimal result only for one relative arrangement of objects/swaths in the scene 36, the sensor surface 40b remains planar (and oriented perpendicular to the optical axis), and the lens 38 is moved the span d in order to provide precise focus for a variety of image distances between s_{ia} and $s_{ia}+d$. Though the sensor surface 40b is flat, movement of the lens 38 creates the effect of a curved sensor surface 40a. It is noted that while the apparatus is described as the lens 38 moving relative to the sensor surface 40b, the lens may remain stationary (relative to a common housing in which both the sensor and lens are mounted) while the sensor is be moved, or both may move in synchronism. All such embodiments are encompassed where the lens is said to move relative to the sensor. Also, the sensor surface is preferably but not necessarily flat; the present invention may be used to impose an effective curvature to the sensor surface regardless of its underlying actual shape.

[0043] In the embodiment of Fig. 7, exposing all of the sensor surface 40b while the lens 38 moves relative to that surface 40b would result in out-of-focus images at those portions of the surface 40b for the time periods where the relative distance between lens 38 and surface 40b are aligned to focus a different swath of the scene 36 (e.g., a different image distance). The present invention solves this dilemma with a rolling shutter, as illustrated schematically at Figs. 8 and 9. Figs. 8 and 9 illustrate the image 42 at the sensor surface 40b, which is a vertically flipped version of the scene 36 of Figs. 6 and 7. At the right of each of those Figures is a plot of the effective (curved) sensor surface 40a that results from movement of the lens 38 over the exposure time. The lens 38 is capable of movement across a distance $d+x$ where the exposure time occurs only during movement over the distance d . For the vast majority of scenes, d will be less than $d+x$. To alleviate large accelerations and decelerations of the lens when it moves, movement of the lens 38 may be initiated prior to the start of the exposure time, and stopped following the end of the exposure time. The discrepancy between start (and stop) of lens movement and start (and stop) of exposure time is preferably less than a tenth or a hundredth of a second; the purpose is to avoid exposure during the instantaneously large accelerations of the lens as it

begins and ends movement. These large accelerations are expected to induce distortions that are much more difficult to control than distortions due to constant-velocity movement of the lens 38 (such as where a line of the sensing surface is exposed for a longer period of time). Large changes in relative acceleration of the lens 38 appear unavoidable in situations where the lens 38 moves in one direction and reverses during a single exposure of the same pixel array or film. Such a reversal of lens direction may be avoided as detailed below.

[0044] In each of Figs. 8 and 9, the image 42 exhibits different swaths, the different swaths corresponding to objects in the scene 36 at a nearer object distance, a further object distance, or somewhere in between. The further object (corresponding to the swath a_i of the Fig. 8 image 42) is focused at a shorter image distance s_{ia} , and the nearer object (corresponding to the swath b_i of the Fig. 8 image 42) is focused at a longer image distance s_{ib} .

[0045] A simple embodiment where different horizontal lines of the actual sensor surface 40b are exposed will first be detailed, and applies for exposure of both traditional film and digital pixels. Exposure of the different horizontal rows of the actual sensor surface 40b occur within a fixed exposure time T_{exp} that is identical for each row, in this embodiment. Exposure among the rows 'rolls' synchronously with the lens 38. When the lens is at the image distance s_{ib} , incoming rays from the object b_i located at the object distance corresponding to that image distance s_{ib} is in focus at a row of pixels that are exposed at that particular time (while the lens 38 is at the image distance s_{ib}). When the lens moves to an image distance s_{ia} , incoming rays from the object a_i located at the object distance corresponding to that image distance s_{ia} is in focus at a row of pixels that are exposed at that particular time. As the lens 38 moves through position s_{ib} , the associated line(s) is/are exposed, but exposure does not continue as the lens 38 moves far from that position s_{ib} . As the lens is in the position s_{ib} , the lines associated with the farther object a_i are not exposed until the lens 38 is closer to position s_{ia} , where that object a_i would be in focus. Fig. 8 illustrates the condition where the lens 38 moves continuously in one direction during a single frame period, such as when imaging the inclined plane of Figs. 6 and 7. A single frame period is the continuous exposure time over which any of the entire array of pixels or plate of film is exposed.

[0046] Fig. 9 illustrates a more typical scene, in which objects are not disposed continuously along a distance spectrum that varies linearly with the horizontal (as in Fig. 8) or vertical. In keeping with the convention established with Figs. 6-8, the scene 36 has a horizontal swath b_i within which a near object is at a distance s_{ob} that corresponds to an image distance s_{ib} for which that object would be focused on that actual sensor surface 40b, a horizontal swath a_i within which a far object is at a distance s_{oa} that corresponds to an image distance s_{ia} for which that object would be focused on that actual sensor surface 40b, and in Fig. 9, there is an additional swath c_i having an object at a distance similar to the swath a_i . However, the swath b_i lies spatially between the swaths a_i and c_i in the image 42, so the lens must reverse direction of relative movement in order to properly focus each, assuming exposure of the lines is identical to that described with Fig. 8. As will be detailed below, the constraints of such an assumption may be avoided in digital photography. The effective sensor surface 40a is shown to the right of Fig. 9. The lens 38 begins at the shorter image distance $s_{ia}=s_{ic}$ where a first line of pixels or film is exposed to image the swath c_i over a time period T_{exp} , moves toward the longer image distance s_{ib} where exposure of the first line has ceased and a second line of pixels or film is exposed to image the swath b_i over a similar exposure time, and returns back to the shorter image distance $s_{ia}=s_{ic}$ where a third line of pixels or film is exposed to image the swath a_i over an exposure time. As will be appreciated, the results of Figs. 8 and 9 may be achieved in either film or digital photography, with the shutter rolling in any direction, vertical, horizontal, or diagonal. Many pixel arrays used in digital photography are read out by rows, facilitating a linearly rolling shutter.

[0047] When the lens is moved synchronously with a linear rolling shutter, the effective curved sensor surface 40a is preferably along the Petzval curve 30. This curve is measured beforehand or is available from the lens design itself. In this instance, the curvature of the effective sensing surface 40a cannot perfectly match the Petzval surface 30 except in the plane shown in Figs. 6-7. This is because the actual Petzval surface is circularly paraboloidal, whereas the lens moves only linearly with respect to the actual sensing surface 40b and cannot correct for curvature in front of and behind the plane illustrated in Figs. 6-7. As detailed below, this may be overcome in a digital camera embodiment of the present invention.

[0048] Depth of field may be extended as compared to the prior art by determining object distances in a scene, calculating the best fit lens position curve to fit the object distances, and taking the picture. In the embodiments of the above descriptions, the best lens curve depends on the orientation of the camera itself, and the camera operator can rotate the camera to achieve a preferred image (as viewed on a digital viewfinder of a camera). For certain images such as a macro of a scene having an insect or business card in a very near field, it may be preferable to use a shallower depth of field where only the object of interest (the insect or business card) is in focus and other objects (background) are purposefully out of focus. In such instances, the selected lens curve exhibits focus only for the object of interest.

[0049] The above illustrations assume the shutter rolls continuously along sequential lines (horizontal, vertical, diagonal). Just as Fig. 9 distinguished the lens reversing its travel during a single frame period, the shutter may roll back and forth during that same frame period. This may cause double exposure in film, but as described above, digital photography need not re-expose the same pixels because it can end integration (exposure) on a pixel-by-pixel basis merely by reading out at a certain time for any particular pixel (or otherwise storing a final voltage reading or other figure of merit related to voltage decay). Further exposure of that pixel, after readout, may further decay retained voltage, but the controlling electronics (e.g., readout circuitry, separate digital signal processor, etc.) can merely ignore any further decay. Thus, digital photography may expand the rolling shutter to roll along different discontinuous sections of pixels to mirror the scene being imaged. This may entail reading out different lines of a pixel array at different times, or reading out individual pixels of the array (where the readout integrated circuit enables individual pixel readout rather than the more common readout by rows).

[0050] Consider Figs 10A-B. Fig. 10A is a scene and Fig. 10B is a sensing surface 40b with pixels (not individually shown) matched to certain objects within that scene. The image of Fig. 10B is inverted as compared to the scene of Fig. 10A, as it would be when the scene is imaged through an optical lens 38. For simplicity, assume the various objects in the scene may be parsed into four distinct object distances, the objects represented in Fig. 10B as a_i , b_i , c_i (two occurrences) and d_i . These objects are at object distances s_{0a} , s_{0b} , s_{0c} and s_{0d} , with matching image distances s_{1a} , s_{1b} , s_{1c} , s_{1d} . As is evident in Fig. 10A, object d_i is the near foreground and exhibits the shortest object distance; object b_i is the stuffed

animal and exhibits a near-medium object distance; objects c_i are the hills and exhibit a far-medium object distance; and object a_i is the sky and exhibits the farthest object distance. So as to maintain the four objects as optically distinct, assume that the only light rays that may be considered as parallel when incoming to the lens 38 are those from the sky, object a_i .

[0051] Clearly, rolling the shutter along sequential horizontal swaths such as those shown in dashed lines 44, 46 will result in some portion of the swath being out of focus. For example, if the lens 38 lies at the image distance s_{ib} while exposing the pixels for swath 44, regions of that swath 44 that image portions of the sky a_i and hills c_i may be out of focus. Instead, distance measuring equipment (such as auto focus apparatus) may be used to determine the distance to the different objects, and the outline of those objects as in Fig. 10B. Pixels along the sensor surface 40b that correspond to the various objects are then exposed only when the lens 38 is at the proper image distance for that particular object. This enables the lens to avoid reversing its direction of movement during a single exposure of the pixilated-array sensing surface in all instances. This is advantageous because the lens movement apparatus is necessarily a mechanical system because it translated the lens 38, whereas adaptive pixel exposure is electronic and therefore precisely controlled at a lower manufacturing cost, and less subject to failure.

[0052] Consider how a rolling shutter would operate for Fig. 10B if it were adaptable to object distances in the scene of Fig. 10B. The lens 38 translates in only one direction, assume away from the sensing surface 40b. At some minimal time period following initiation of lens movement, the lens 38 is at image distance s_{ia} , at which time only those pixels within the outline of object a_i are exposed. For now, assume a constant integration time/exposure time T_{exp} . As the lens moves further from the sensing surface 40b and through the image distance s_{ic} , those pixels within the outline of the hills c_i are exposed, and so forth through the image distances s_{ib} and s_{ia} , at which time all exposure ceases and the lens 38 halts movement shortly thereafter. Field curvature is corrected in the resulting image to the precision of the distance measuring equipment, depth of field is greatly increased because the resulting image is made from four image distances rather than one, and the same advantage may be extended to any scene, regardless of relative positions of the objects therein.

[0053] Now consider varying exposure time of the individual pixels. In Fig. 10A, the sky a_i , hills c_i , and foreground d_i are relatively bright while the central object, the stuffed animal b_i that is the (aesthetic) focus of the scene, is dark. Film or digital, the known prior art would expose all four object for the same exposure time/integration time, finding a acceptable middle ground where the darker central object b_i is exposed sufficiently so as to exhibit some detail in the resulting image, but where the peripheral but bright objects a_i , c_i , and d_i are not overexposed and 'bleached'. In the digital embodiment, the present invention suffers no such limitation of constant exposure for all pixels of the sensing surface 40b. As the lens 38 moves, the pixels corresponding to the darker objects such as the stuffed animal b_i may be exposed/integrated over a longer period of time as compared to the lighter objects such as the sky a_i , hills c_i , and foreground d_i . More particularly, the stuffed animal b_i has a dark body but white tusks; pixels corresponding to the darker body may be exposed for a longer period of time as compared to those corresponding to the white tusks to achieve better detail in the body without overexposing the tusks. Light sensing equipment is well known in the camera arts, and can be used in conjunction with distance measuring equipment to determine, prior to the start of any frame period, the object distances and relative brightness of each object. Brightness of the overall image may be set by normalizing the brightness of each pixel or separate sections of pixels based on their relative integration times. This is seen as a superior approach to digital enhancement of exiting digital images as currently practices, because it is understood that current practice is to enhance using generic algorithms whereas normalizing brightness after brightness-adaptive exposure takes its universe of information from the actual scene as captured by the pixels.

[0054] As briefly noted above, exposure time may also be adaptive to object motion. Shorter exposure times are necessary to accurately focus moving objects, at the cost of brightness. Non-moving or slowly moving objects may enable a longer exposure time without appreciable loss of sharpness or focus in the resulting image. Using known movement detection equipment that operates on the same principle as distance measuring equipment, movement of different objects within a scene may be categorized, and pixels corresponding to the individual objects may be exposed for a short or longer period depending upon relative movement of the objects themselves. Determining the exact pixels for which a fast-moving object is to be captured is merely a matter of extrapolating

which pixels would image the moving object at the time the lens is at that object's image distance based on (past) detected movement.

[0055] Fig. 11 is a sectional schematic block diagram of a mobile station MS 50, such as a cellular telephone, a personal digital assistant with two-way communications capability, or any other handheld portable device of similar functionality. The MS 50 includes a digital signal processor DSP 52, powered by a galvanic power source such as a battery 54 and coupled to transducers 55 (speaker) and 56 (microphone). Receiving circuitry 58 and transmitting circuitry 60 are coupled through a switch or dipole filter 62 to one or more antennas 64. A graphical display interface 66 by which a user views text and images is controlled by a display driver 68. Similarly, a user input pad 70, such as may include buttons, joysticks, and/or touch sensitive areas, is controlled by an input driver 72.

[0056] Computer programs for operating the various sub-systems of the MS 50 are stored in a memory 76, which may be a combination of volatile and non-volatile storage media, possibly dispersed among various spatial locations within the housing 74, which is a computer readable storage media for data and programs. Various other buffers, filters, encoders and the like are also within the housing 74, but peripheral to the invention. One or more detectors 78 penetrate the housing 74 and are used to measure object distances, object brightness, or relative object movement/speed in a scene when the DSP 52 is in condition to take a picture (image).

[0057] There are several possibilities to measure object distances, for example, using the camera and an illuminator creating a typically diverging light spot/pattern, wherein the size, position or intensity of the spot/pattern is determined from the image. It is possible also to use different type of time-of-flight measurement principles, that might be implemented either optically or using even acoustic principles. In order to measure object brightness, one method is to use the camera itself for capturing a test image where the brightness of the object is then determined. This can be done before the actual final image is captured during the framing phase when the user is aiming the camera in order to frame the image properly for the shot. By capturing several images with different exposure times, optimal exposure times for different areas of the image can be determined. However, the invention is not limited to the above mentioned examples of determining the object properties or suitable exposure levels.

[0058] The DSP is in condition to take a picture when it provides a pre-charge to pixels on a pixilated array that form a sensing surface 40b at which an image is electronically captured. The surface 40b may preferably be directly mounted to a readout integrated circuit ROIC 80 or merely coupled electronically. The ROIC 80 may control each pixel individually, it may control them according to rows/lines, or it may control them according to contiguous groupings (e.g., groups of four pixels forming a square, five pixels forming a diamond with one pixel in the center, etc.). Integration times for each pixel or row or group of pixels may be started and stopped at times independent of that for other pixels or rows or groups of pixels, based on the design of the readout circuitry.

[0059] A lens 38 is mounted to upper and lower rails 82 and translates along the optical axis of the lens by use of mechanical linkage such as an extendable scissors arrangement or less optimally a rotating shaft with a continuous groove about it similar to a screw. Such mechanical linkage is well known in the art for manually or automatically changing an image distance of a conventional camera lens. The distinction over a conventional auto focus camera lens is that the linkage operates to move the lens during the exposure frame period, rather than moving it prior to the start of that exposure frame period. A window 84 is aligned with the lens and allows light from a scene to pass through the housing 74 and the lens 38 to expose various pixels of the surface 40b. A computer program to operate the mechanical linkage in synchronous relation to the integration/exposure of the various different pixels along the surface 40b is stored in the memory 76 and executed by the DSP 52. This program may also use inputs from the detectors 78 to adjust the synchronous lens movement/pixel exposure actions according to the scene. Particularly, exposure of certain pixels may occur when the lens is at an image distance corresponding to an object distance measured at the detectors 78; exposure time for certain pixels may be predicated on an object's speed or brightness as determined by the detectors 78. Various adaptations of this MS-based embodiment are also possible, as detailed above. Fig. 11 illustrates only one embodiment, the rest of which will be obvious given the above detailed description of various adaptations such as translating the sensor surface 40b rather than or in conjunction with the lens 38; reading out the pixels by row only; and using film rather than a pixilated array, among others.

[0060] Further, the effect similar to moving the lens(es) and/or sensing surface, may also be accomplished using a liquid lens or other techniques, where the focal length

of the lens itself is changed by changing the shape or refraction index of the optical material of the lens(es). U.S. Pat. No. 6,369,954 describes an optical lens having two liquids with different optical indices, one being conductive and one being non-conductive. The image distance is changed by applying a voltage to the conductive liquid, which then changes shape so that the focal length of the lens itself is changed. In the liquid lens arrangement of the 6,369,954 patent, a first image distance arises from a first lens shape. A second image distance arises from a second lens shape, even though the first and second image distances behind the changed lens at which light from different object distances is focused may be identical. This is true because it is the shape of the lens itself that changes, effectively changing the image distance. The same result holds where the refractive index of the lens or some medium between the lens and the sensor is changed, or other embodiments that avoid or reduce the necessity of moving the lens and sensor components relative to one another. In all cases, the effective image distance is changed. Moving a traditional lens relative to the sensing surface, or changing the lens shape or refractive index, or changing the refractive index of some medium between the lens and sensing surface, are all ways to change the optical relationship between the lens and the sensing surface so as to maintain the sensing surface at different effective image distances during the imaging of a single scene in a single, continuous exposure of the sensing surface.

[0061] Although described in the context of particular embodiments, it will be apparent to those skilled in the art that a number of modifications and various changes to these teachings may occur. Thus, while the invention has been particularly shown and described with respect to one or more embodiments thereof, it will be understood by those skilled in the art that certain modifications or changes may be made therein without departing from the scope and spirit of the invention as set forth above, or from the scope of the ensuing claims.

CLAIMS:

WHAT IS CLAIMED IS:

1. A method for imaging a scene comprising:
manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and
exposing different portions of the image sensing surface synchronous with manipulating the optical relationship.
2. The method of claim 1, wherein at least one of manipulating the optical relationship and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.
3. The method of claim 1, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.
4. The method of claim 3, wherein manipulating the optical relationship comprises manipulating between a first effective image distance and a second effective image distance, wherein the first and second effective image distances correspond respectively to the first and second object distances.
5. The method of claim 1, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.
6. The method of claim 1, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.
7. The method of claim 1, wherein the image sensing surface comprises an array of pixels in adjacent rows, wherein a first portion of the array is exposed while the image sensing surface is at a first effective image distance, and a second portion of the array is

exposed while the sensing surface is at a second effective image distance, and wherein at least one pixel of the first portion is in the same row of the array as at least one pixel of the second portion.

8. The method of claim 1, wherein manipulating the optical relationship synchronously with exposing operates to impose an effective curvature to the sensing surface, at least a cross section of said effective curvature approximating at least a cross section of a Petzval surface.
9. The method of claim 1, wherein the image sensing surface comprises photographic film.
10. The method of claim 1, wherein the image sensing surface comprises an array of photosensitive pixels.
11. The method of claim 1, wherein manipulating the optical relationship comprises moving at least one of the lens and the sensing surface relative to one another.
12. The method of claim 1, wherein manipulating the optical relationship comprises altering a shape of the lens.
13. A method for imaging a scene comprising:
 - determining a first object distance between a first object in a scene and a lens;
 - determining a second object distance between a second object in the scene and the lens;
 - within a continuous exposure frame:
 - exposing a first portion of an image sensing surface while the image sensing surface is at a first effective image distance from the lens, where the first effective image distance corresponds to the first object distance;
 - exposing a second portion of the image sensing surface while the image sensing surface is at a second effective image distance from the lens, where the second effective image distance corresponds to the second object distance; and
 - combine the exposed first and second portions into a single image.

14. The method of claim 13, wherein the single image is displayed on a digital graphical user interface.
15. The method of claim 13, wherein exposing the first and second portion of the image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected brightness of the first and second objects.
16. The method of claim 13, wherein exposing the first and second portion of the image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected speed of movement of the first and second objects.
17. A camera comprising:
a lens;
an image sensor having a sensing surface;
exposure means for separately exposing different portions of the sensing surface within a single exposure frame;
means for manipulating an optical relationship between the lens and the sensing surface so that the sensing surface lies at a changeable effective image distance;
a processor for synchronizing the means for manipulating with the exposure means.
18. The camera of claim 17, further comprising:
measuring equipment for determining an optical parameter for each of a first and a second object in a scene;
wherein the processor controls one of the means for manipulating and the exposure means based on the determined optical parameters.
19. The camera of claim 18, wherein the optical parameter is object distance from the lens, and the processor controls the means for manipulating to match the changeable effective image distances to the object distances of the first and second objects.
20. The camera of claim 18, wherein the optical parameter is object movement and the processor controls the exposure means to expose a first portion of the sensing surface for a first time span and a second portion of the sensing surface for a second time span.

21. The camera of claim 18, wherein the optical parameter is object brightness and the processor controls the exposure means to expose a first portion of the sensing surface for a first time span and a second portion of the sensing surface for a second time span.
22. The camera of claim 17, wherein the image sensor comprises an array of pixels and readout circuitry for reading out pixels according to rows.
23. The camera of claim 17, wherein the image sensor comprises an array of pixels and readout circuitry for reading out individual pixels.
24. The camera of claim 17 disposed in a mobile station, the mobile station comprising a graphical display interface for displaying a scene imaged by the image sensor.
25. A program of machine-readable instructions, tangibly embodied on an information bearing medium and executable by a digital data processor, to perform actions directed toward operating a camera, the actions comprising:
during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface.
26. The program of machine-readable instructions according to claim 25, wherein at least one of maintaining the image sensing surface at a variable effective image distance and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.
27. The program of machine-readable instructions according to claim 25, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.
28. The program of machine-readable instructions according to claim 27, wherein maintaining an image sensing surface at a variable effective image distance comprises varying between a first and a second image distance that respectively correspond to the first and second object distances.

29. The program of machine-readable instructions according to claim 25, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.
30. The program of machine-readable instructions according to claim 25, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.
31. The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises an array of pixels for which the program controls exposure of pixels according to rows.
32. The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises an array of pixels for which the program controls exposure of pixels individually.
33. The program of machine-readable instructions according to claim 25, wherein maintaining an image sensing surface at a variable effective image distance synchronously with exposing operates to impose an effective curvature to the sensing surface, at least a cross section of said effective curvature approximating at least a cross section of a Petzval surface.
34. The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises photographic film.
35. The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises an array of photosensitive pixels.
36. The program of claim 25, wherein maintaining the image sensing surface at a variable effective image distance from the lens comprises moving the lens relative to the sensing surface.

37. The program of claim 25, wherein maintaining the image sensing surface at a variable effective image distance from the lens comprises changing a shape of the lens.
38. An apparatus for adaptively imaging a scene, comprising:
means for focusing light from a scene;
means for imaging the focused light;
means for determining a first and second object distance;
means for differentially exposing selectable portions of the sensing surface to light passing through the means for focusing;
means for varying an effective image distance between the means for focusing light and means for imaging; and
means for synchronizing the means for varying with the means for differentially exposing.
39. The apparatus of claim 38, wherein:
the means for focusing light comprises a lens;
the means for differentially exposing comprises a readout integrated circuit for reading out individual one of or select groups of pixels that form the means for imaging;
the means for varying an image distance comprises mechanical linkage for translating at least one of the lens and the means for imaging relative to one another along an optical axis; and
the means for synchronizing comprises a processor executing a computer program.
40. A method of imaging a scene comprising:
imposing on a sensing surface an effective optical curvature that depends from a scene, and
collecting an electronic image of the scene at the sensing surface with the effective optical curvature.
41. A device comprising:
a device housing;
a lens;
an image sensor having a sensing surface;

exposure means for separately exposing different portions of the sensing surface within a single exposure frame period to light passing into the housing and through the lens;

optical manipulation means for maintaining the image sensor at a variable effective image distance from the lens;

a digital signal processor DSP for synchronizing the optical manipulation means with the exposure means.

42. The device of claim 41 that comprises a portable handheld device with an internal source of electrical power.

43. The device of claim 41 that comprises a two-way wireless communication device.

44. The device of claim 41 wherein the optical manipulation means comprises mechanical linkage to move the lens relative to the image sensor.

45. The device of claim 41 wherein the optical manipulation means comprises voltage leads coupled to a power source and to the lens for changing a shape of the lens shape responsive to voltage applied to the lens.

ADAPTIVE OPTICAL PLANE FORMATION WITH ROLLING SHUTTER

ABSTRACT OF THE DISCLOSURE:

A scene is imaged by moving an optical lens relative to an image sensing surface (such as film or a pixel array) synchronously with exposing different portions of the image sensing surface. The synchronous actions are preferably adaptable to the scene being imaged, so objects at different object distances are focused at different times and exposed to different portions of the sensing surface at different times within an exposure frame period. Exposure time for the different portions of the sensor may be varied according to speed or brightness of the different objects in the scene to be imaged, as detected at the camera by measuring apparatus similar to auto focus distance measuring apparatus. A camera and a program of computer readable instructions are also detailed. Alternatives to moving the lens relative to the image sensing surface include changing a shape of the lens.

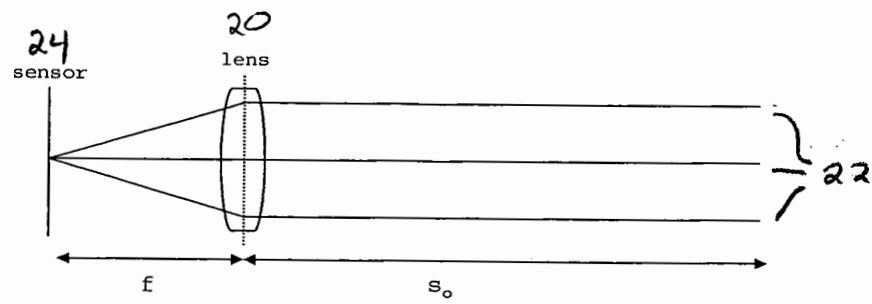


Fig. 1: Prior Art

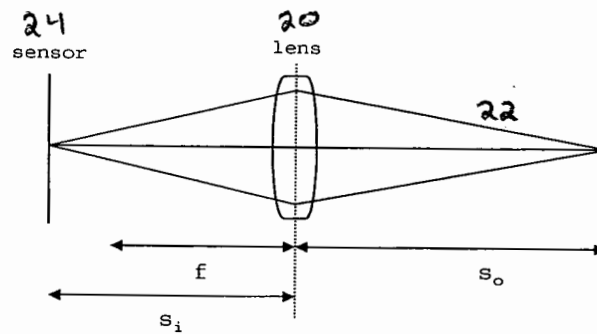


Fig. 2A: Prior Art

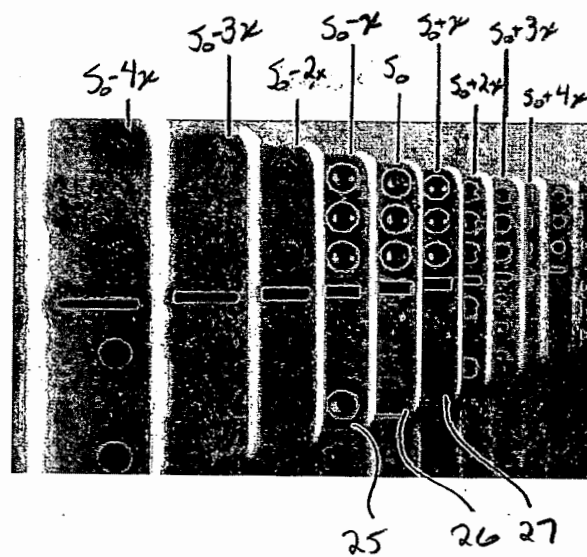


Fig. 2B: Prior Art

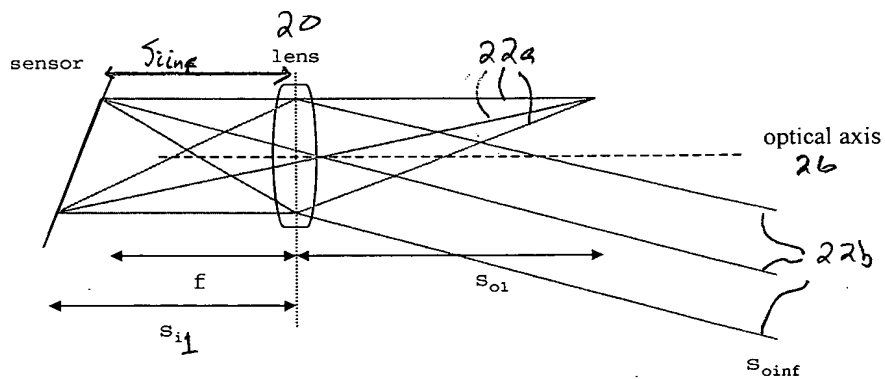


Fig. 3: Prior Art

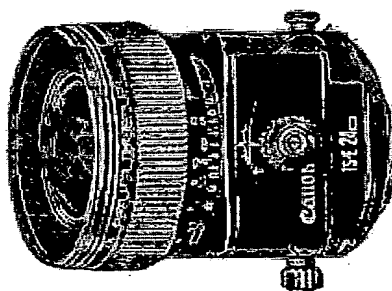


Fig. 4: Prior Art

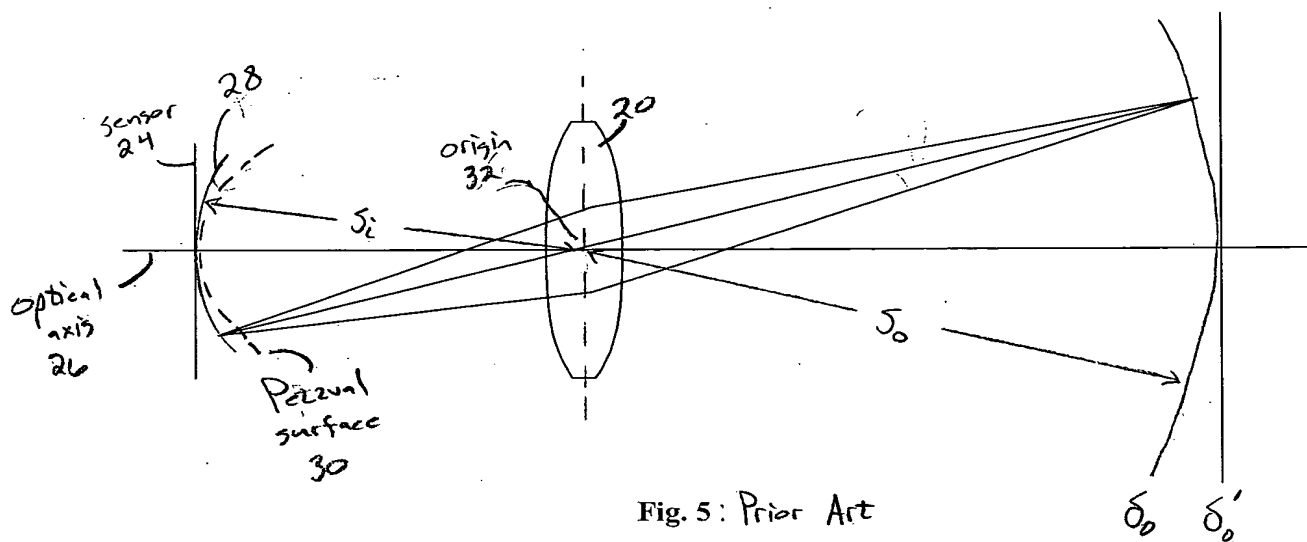


Fig. 5: Prior Art

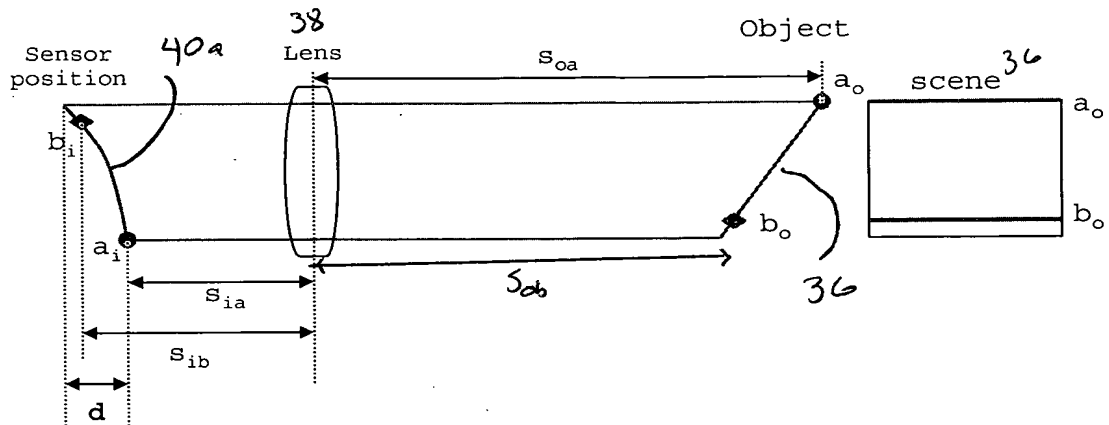


Fig. 6

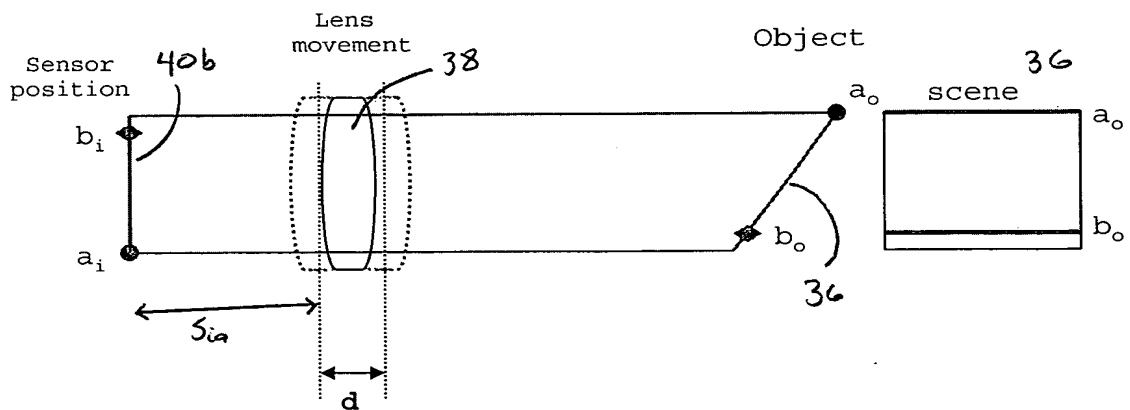


Fig. 7

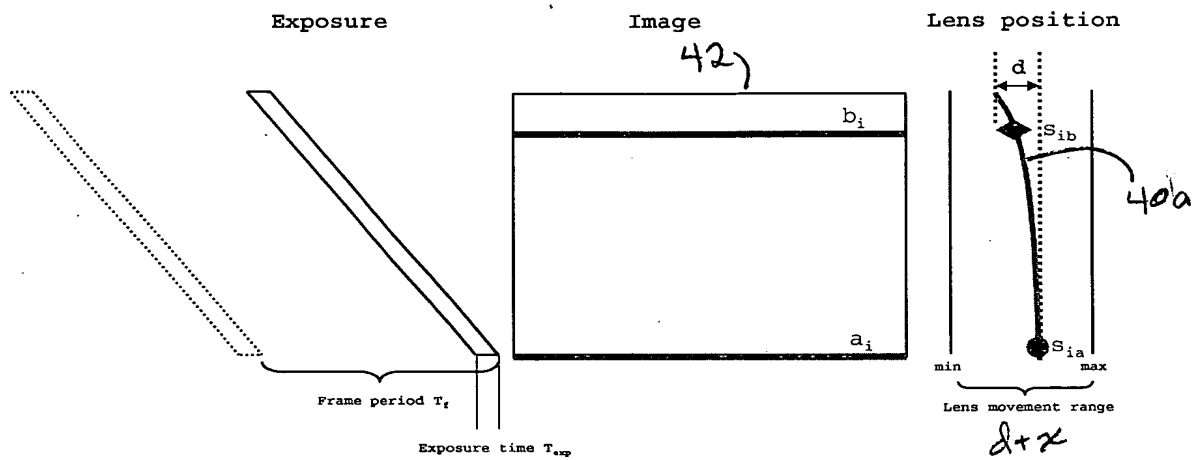


Fig. 8

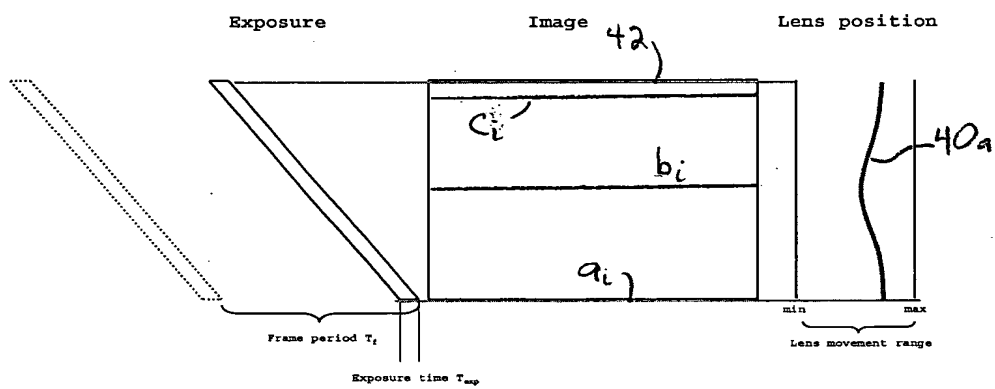


Fig. 9



Fig. 10A

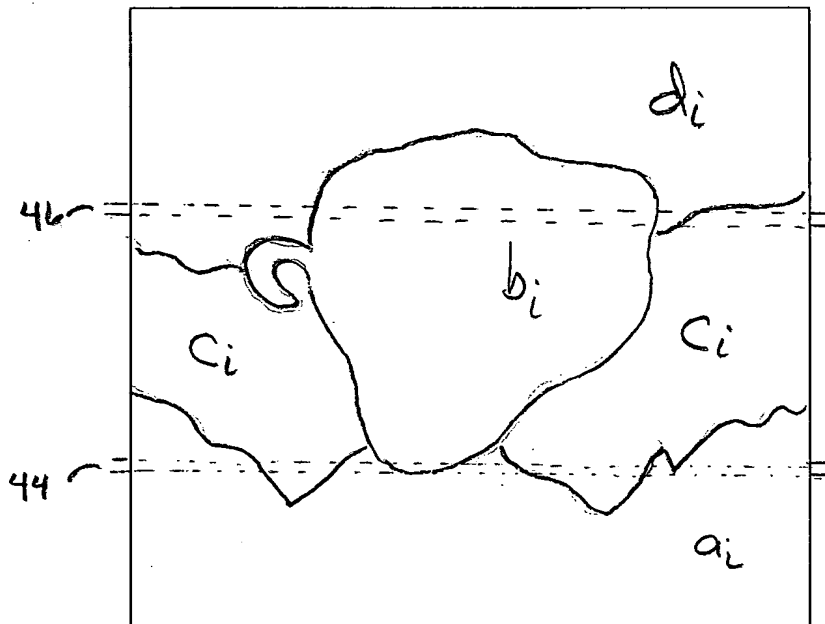


Fig. 10B

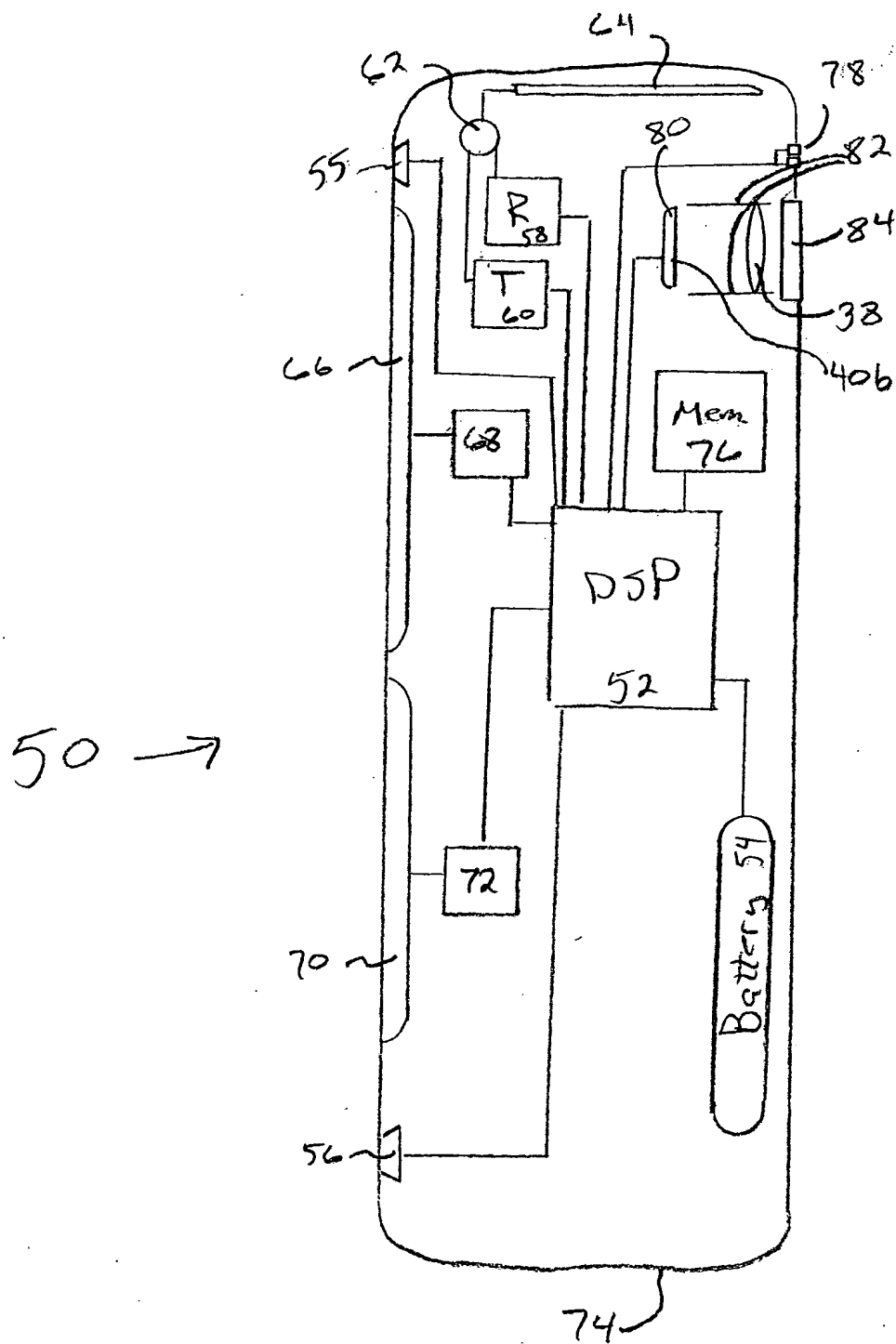


Fig 11

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PATENT APPLICATION SERIAL NO. _____

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PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

06/28/2005 EAYALEW1 00000034 11165992

01 FC:1011	300.00	OP
02 FC:1111	500.00	OP
03 FC:1311	200.00	OP
04 FC:1201	800.00	OP
05 FC:1202	1250.00	OP

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11/165,992

APPLICATION AS FILED - PART I

(Column 1)

(Column 2)

SMALL ENTITY

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SMALL ENTITY**

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE (37 CFR 1 16(a), (b), or (c))	N/A	N/A
SEARCH FEE (37 CFR 1 16(k), (l), or (m))	N/A	N/A
EXAMINATION FEE (37 CFR 1 16(o), (p), or (q))	N/A	N/A
TOTAL CLAIMS (37 CFR 1 16(i))	45 minus 20 =	25
INDEPENDENT CLAIMS (37 CFR 1 16(h))	7 minus 3 =	4
APPLICATION SIZE FEE (37 CFR 1 16(s))	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).	
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1 16(j))		

RATE (\$)	FEE (\$)
N/A	150.00
N/A	\$250
N/A	\$100
X\$ 25 =	
X100 =	
+180=	
TOTAL	

OR

RATE (\$)	FEE (\$)
N/A	300.00
N/A	\$500
N/A	\$200
X\$50 =	1250
X200 =	800
+360=	
TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED - PART II

(Column 1)

(Column 2)

(Column 3)

SMALL ENTITY

OR

**OTHER THAN
SMALL ENTITY**

AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(i))	•	Minus **	=
Independent (37 CFR 1.16(h))	•	Minus ***	=
Application Size Fee (37 CFR 1.16(s))			
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))			

RATE (\$)	ADDI- TIONAL FEE (\$)
X\$ 25 =	
X100 =	
+180=	
TOTAL ADD'L FEE	

OR

OR

OR

OR

RATE (\$)	ADDI- TIONAL FEE (\$)
X\$50 =	
X200 =	
+360=	
TOTAL ADD'L FEE	

(Column 1)

(Column 2)

(Column 3)

AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(i))	•	Minus **	=
Independent (37 CFR 1.16(h))	•	Minus ***	=
Application Size Fee (37 CFR 1.16(s))			
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))			

RATE (\$)	ADDI- TIONAL FEE (\$)
X\$ 25 =	
X100 =	
+180=	
TOTAL ADD'L FEE	

OR

OR

OR

OR

RATE (\$)	ADDI- TIONAL FEE (\$)
X\$50 =	
X200 =	
+360=	
TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. 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 12 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.

Serial No.:

Filing Date: herewith

Group:

[illegible][illegible][illegible]

Date Considered:

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered.
Include a copy of this citation form with your next correspondence to the Applicant(s).



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
 United States Patent and Trademark Office
 Address: COMMISSIONER FOR PATENTS
 P.O. Box 1450
 Alexandria, Virginia 22313-1450
 www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
11/165,992	06/24/2005	Hannu Kakkori	877.0006.U1(US)

29683
 HARRINGTON & SMITH, LLP
 4 RESEARCH DRIVE
 SHELTON, CT 06484-6212

CONFIRMATION NO. 3430

FORMALITIES LETTER



OC000000016562634

Date Mailed: 07/20/2005

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

*Filing Date Granted***Items Required To Avoid Abandonment:**

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is missing. *A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.*
Note: If a petition under 37 CFR 1.47 is being filed, an oath or declaration in compliance with 37 CFR 1.63 signed by all available joint inventors, or if no inventor is available by a party with sufficient proprietary interest, is required.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(f) of \$130 for a non-small entity, must be submitted with the missing items identified in this letter.

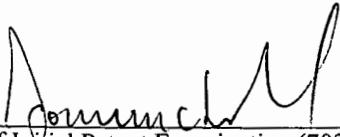
SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is **\$130** for a Large Entity

- **\$130** Late oath or declaration Surcharge.

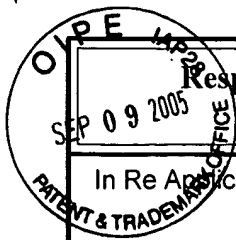
Replies should be mailed to: Mail Stop Missing Parts
 Commissioner for Patents
 P.O. Box 1450
 Alexandria VA 22313-1450

*A copy of this notice **MUST** be returned with the reply.*

A handwritten signature in black ink, appearing to be "Dennis C. M.", written over a horizontal line.

Office of Initial Patent Examination (703) 308-1202

PART 3 - OFFICE COPY



**Response To Notice To File Missing Parts Of Application
Filing Date Granted (PTO-1533)(Large Entity)**

Docket No.
877.0006.U1(US)

In Re Application Of: Hannu Kakkori

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
11/165,992	06/24/2005	Not Yet Assigned	29683	2851	3430

Invention: Adaptive Optical Plane Formation With Rolling Shutter

Mail Stop Missing Parts

COMMISSIONER FOR PATENTS:

This is a response to the Notice to File Missing Parts of Application - Filing Date Granted (PTO-1533) mailed on
July 20, 2005
Date

Enclosed herewith for filing are the following:

- ☒ A copy of the Notice to File Missing Parts of Application - Filing Date Granted (PTO-1533). **(REQUIRED)**
- ☐ An oath or declaration in compliance with 37 CFR 1.63, including residence information and identifying the application by the above Application Number and Filing Date.
- ☒ A properly signed oath or declaration in compliance with 37 CFR 1.63.
- ☐ An oath or declaration in compliance with 37 CFR 1.63 listing the names of all inventors and signed by the omitted inventor(s), identifying this application by the above Application Number and Filing Date.
- ☐ A verified English translation of the non-English language application papers as originally filed. It is requested that this translation be used as the copy for examination purposes in the United States Patent and Trademark Office.
- ☒ Other (list):

Transmittal of Formal Drawings
Eight (8) Sheets, Figures 1-11

**Response To Notice To File Missing Parts Of Application
Filing Date Granted (PTO-1533)(Large Entity)**

Docket No.
877.0006.U1(US)

In Re Application Of: **Hannu Kakkori**

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
11/165,992	06/24/2005	Not Yet Assigned	29683	2851	3430

Invention: **Adaptive Optical Plane Formation With Rolling Shutter**

TO THE COMMISSIONER FOR PATENTS:

Mail Stop Missing Parts

☒ Completion of application fees as calculated below:

- | | |
|---|-----------------|
| <input type="checkbox"/> Utility application basic fee | _____ |
| <input type="checkbox"/> Design application basic fee | _____ |
| <input type="checkbox"/> Search Fee | _____ |
| <input type="checkbox"/> Examination Fee | _____ |
| <input type="checkbox"/> Total number of independent claims = _____ | _____ |
| <input type="checkbox"/> Total number of claims = _____ | _____ |
| <input type="checkbox"/> Multiple dependent claims | _____ |
| <input checked="" type="checkbox"/> Surcharge for late payment of filing fee and/or late filing of original declaration or oath | \$130.00 |
| <input type="checkbox"/> Petition and fee for filing by other than all the inventors or a person not the inventor | _____ |
| <input type="checkbox"/> Fee for processing an application filed with a non-English language specification | _____ |
| <input type="checkbox"/> Fee for processing and retention of application | _____ |

Total completion of application fees **\$130.00**

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a response to the above-identified Notice to File Missing Parts of Application. The requested extension is as follows (check time period desired). If an additional time extension is required, please consider this a petition therefor.

☐ One month ☐ Two months ☐ Three months ☐ Four months ☐ Five months

from: _____ until: _____
Date Date

Total time extension fees _____

Total fees due **\$130.00**

**Response To Notice To File Missing Parts Of Application
Filing Date Granted (PTO-1533) (Large Entity)**

Docket No.
877.0006.U1(US)

In Re Application Of: **Hannu Kakkori**

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
11/165,992	06/24/2005	Not Yet Assigned	29683	2851	3430

Invention: **Adaptive Optical Plane Formation With Rolling Shutter**

TO THE COMMISSIONER FOR PATENTS:

Mail Stop Missing Parts

The fee of **\$130.00** is to be paid as follows:

- ☒ A check in the amount of the fee is enclosed.
- ☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account No. **50-1924**
- ☒ If an additional extension of time is required, please consider this a petition therefor and charge any additional fees which may be required to Deposit Account No. **50-1924**
- ☐ Payment by credit card. Form PTO-2038 is attached.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.


Signature

Dated: Sep 6, 2005

Gerald J. Stanton (Reg. No. 46,008)
Harrington & Smith, LLP
4 Research Drive
Shelton, CT 06484-6212
Customer No. 29683

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to "Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450" [37 CFR 1.8(a)] on

September 7 2005
(Date)

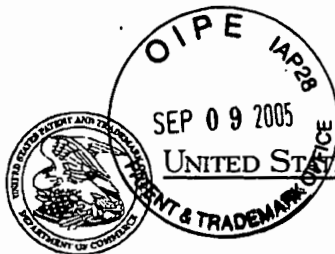


Signature of Person Mailing Correspondence

Debra Pongetti

Typed or Printed Name of Person Mailing Correspondence

cc:



UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
11/165,992	06/24/2005	Hannu Kakkori	877.0006.U1(US)

29683
HARRINGTON & SMITH, LLP
4 RESEARCH DRIVE
SHELTON, CT 06484-6212

CONFIRMATION NO. 3430

FORMALITIES LETTER



OC000000016562634

Date Mailed: 07/20/2005

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

09/12/2005 HDESTA1 00000037 11165992

01 FC:1051

130.00 OP

FILED UNDER 37 CFR 1.53(b)

*Filing Date Granted***Items Required To Avoid Abandonment:**

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is missing. *A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.*
Note: If a petition under 37 CFR 1.47 is being filed, an oath or declaration in compliance with 37 CFR 1.63 signed by all available joint inventors, or if no inventor is available by a party with sufficient proprietary interest, is required.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(f) of \$130 for a non-small entity, must be submitted with the missing items identified in this letter.

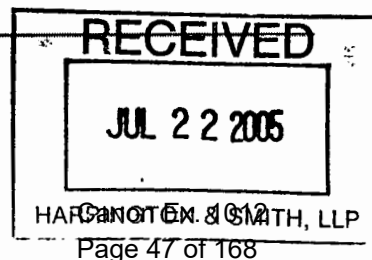
SUMMARY OF FEES DUE:

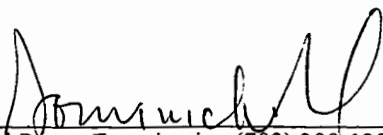
Total additional fee(s) required for this application is **\$130** for a Large Entity

- **\$130** Late oath or declaration Surcharge.

Replies should be mailed to: Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

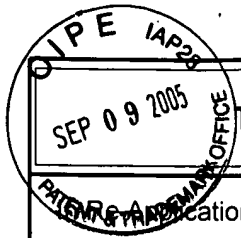
*A copy of this notice **MUST** be returned with the reply.*



A handwritten signature in black ink, appearing to read "Domich", is written over a horizontal line.

Office of Initial Patent Examination (703) 308-1202

PART 2 - COPY TO BE RETURNED WITH RESPONSE



TRANSMITTAL OF FORMAL DRAWINGS

Docket No.
877.0006.U1(US)

Application Of: Hannu Kakkori

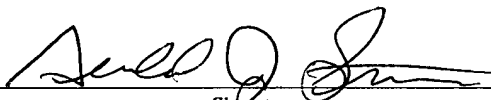
Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
11/165,992	06/24/2005	Not Yet Assigned	29683	2851	3430

Invention: Adaptive Optical Plane Formation With Rolling Shutter

Address to:
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Transmitted herewith are:

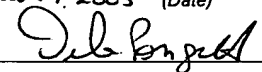
8 sheets of formal drawing(s) for this application.

☒ Each sheet of drawing indicates the identifying indicia suggested in 37 CFR Section 1.84(c).
Signature

Dated: Sep 6, 2005

Gerald J. Stanton (Reg. No. 46,008)
Harrington & Smith, LLP
4 Research Drive
Shelton, CT 06484-6212
Customer No. 29683

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to "Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450" [37 CFR 1.3(a)] on September 7, 2005 (Date)


Signature of Person Mailing Correspondence

Debra Pongetti

Typed or Printed Name of Person Mailing Correspondence

1/8

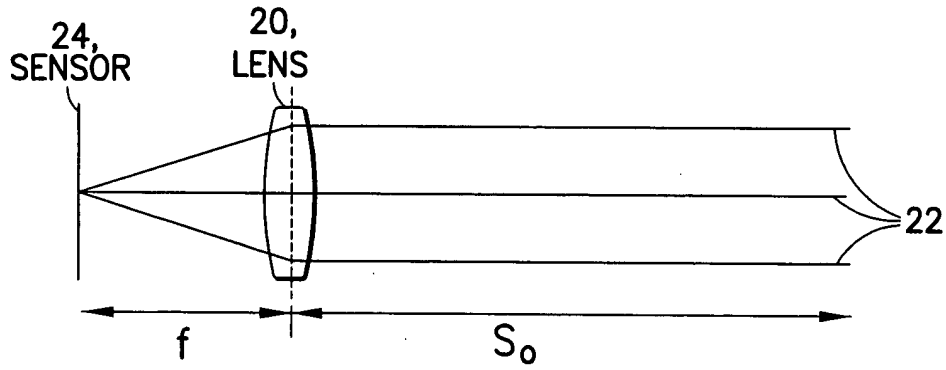


FIG. 1
PRIOR ART

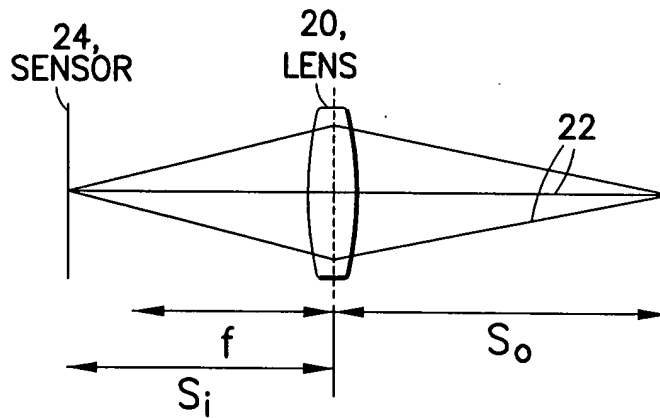


FIG. 2A
PRIOR ART

2/8

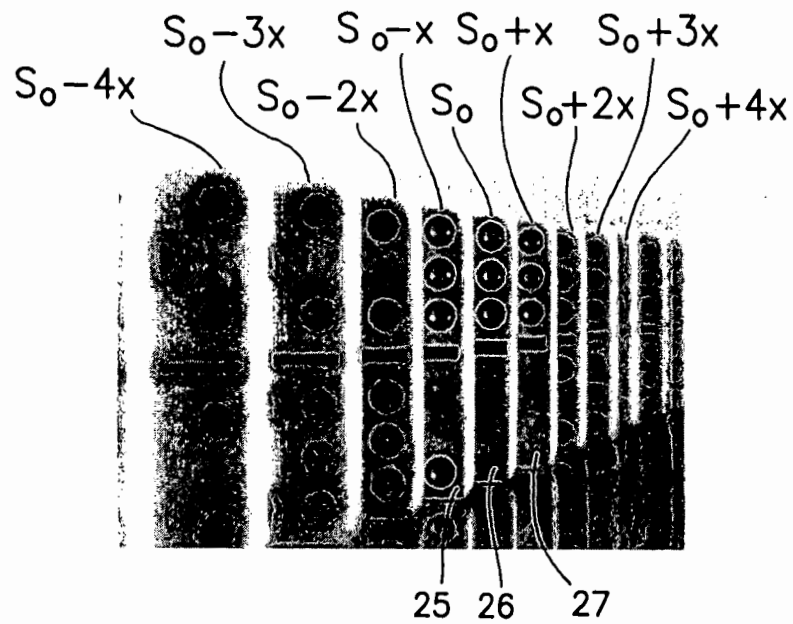


FIG. 2B
PRIOR ART

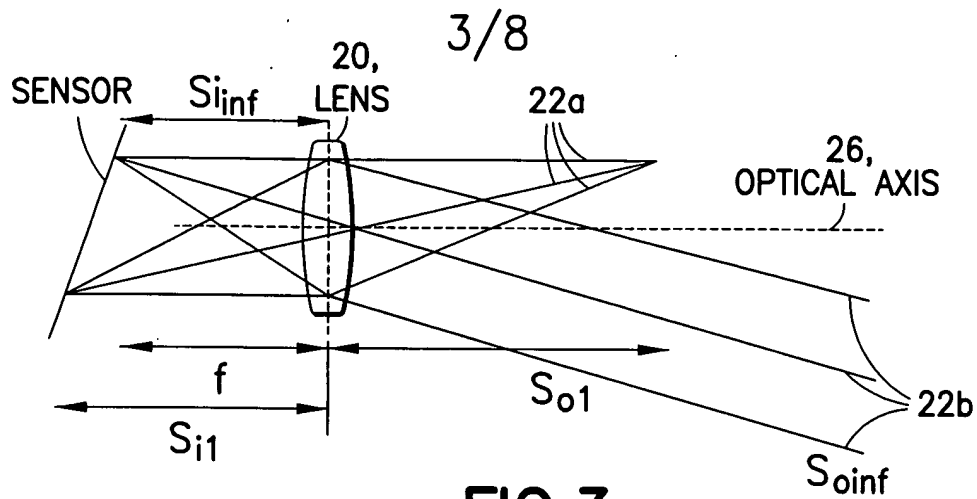


FIG. 3
 PRIOR ART

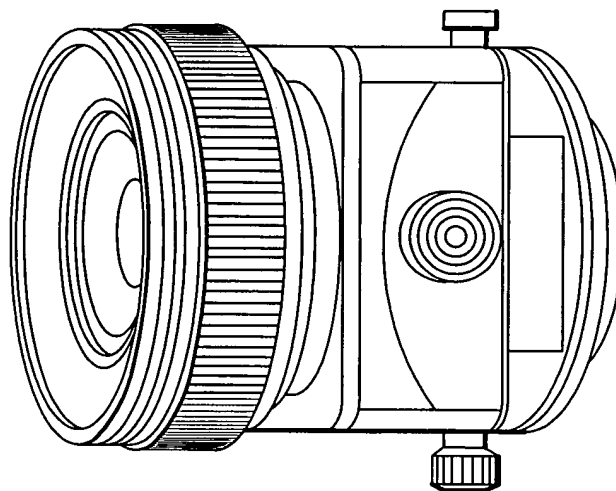


FIG. 4
 PRIOR ART

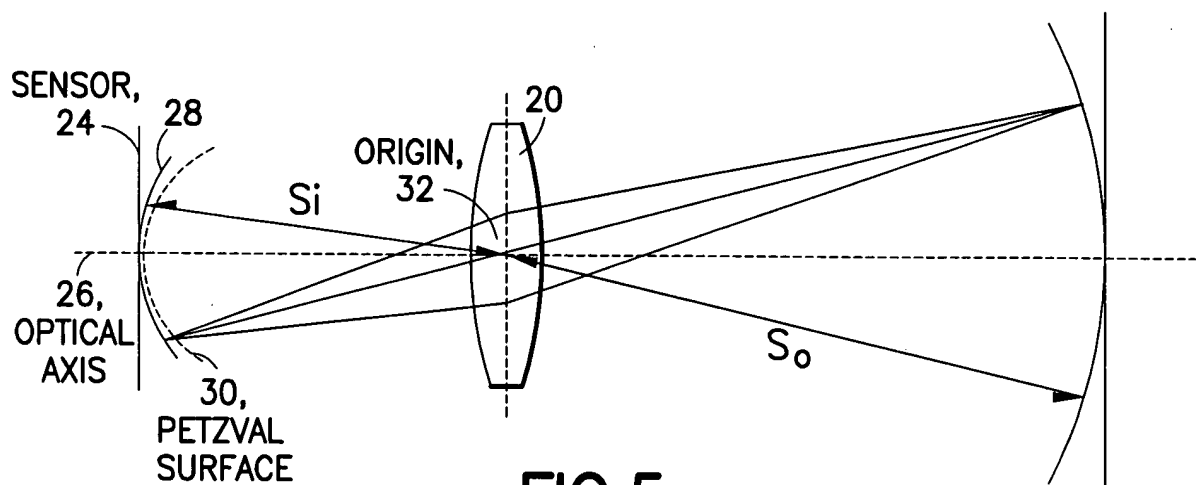


FIG. 5
 PRIOR ART

4/8

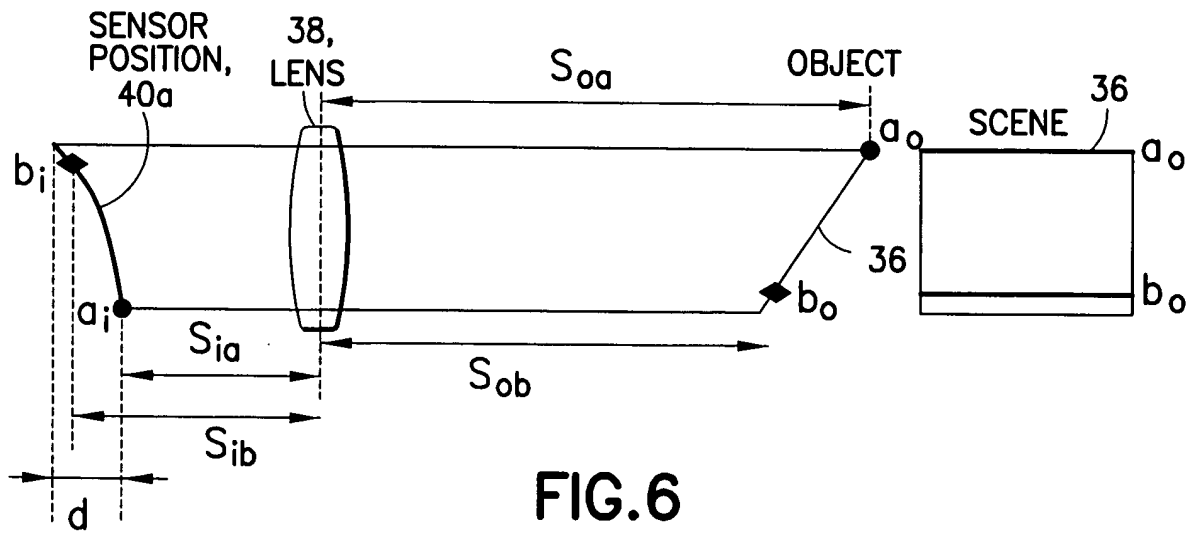


FIG. 6

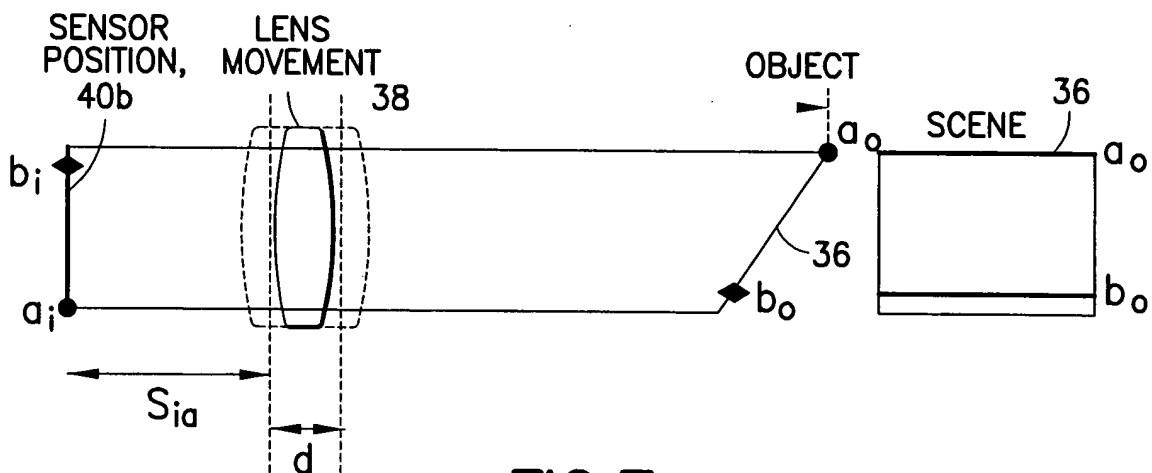


FIG. 7

5/8

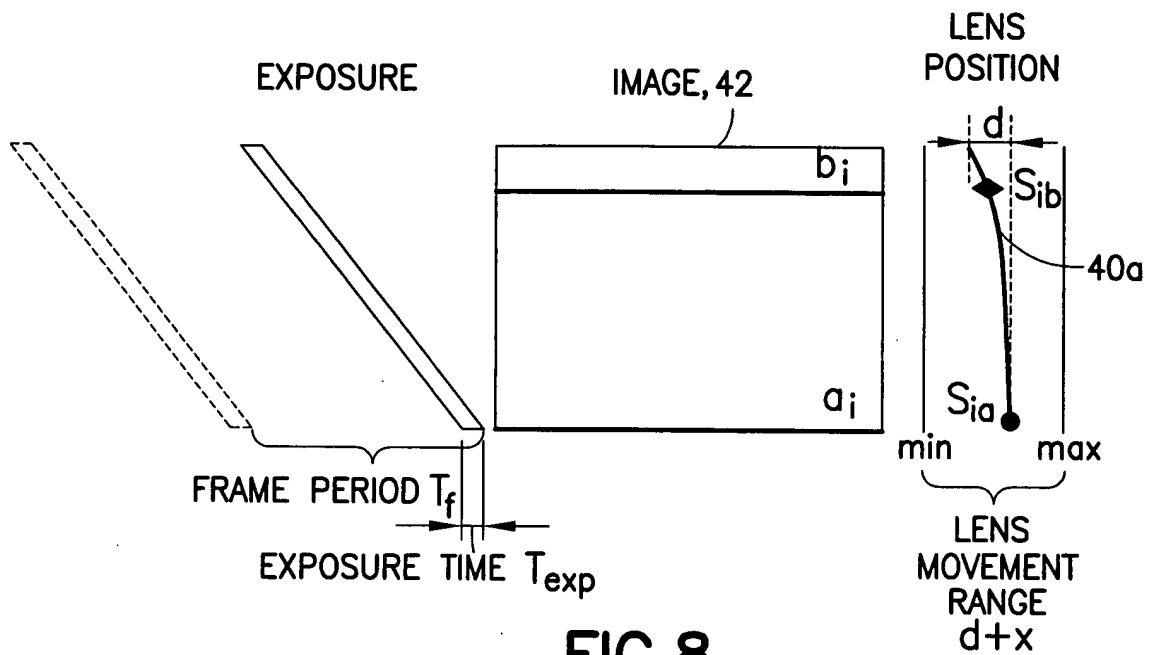


FIG. 8

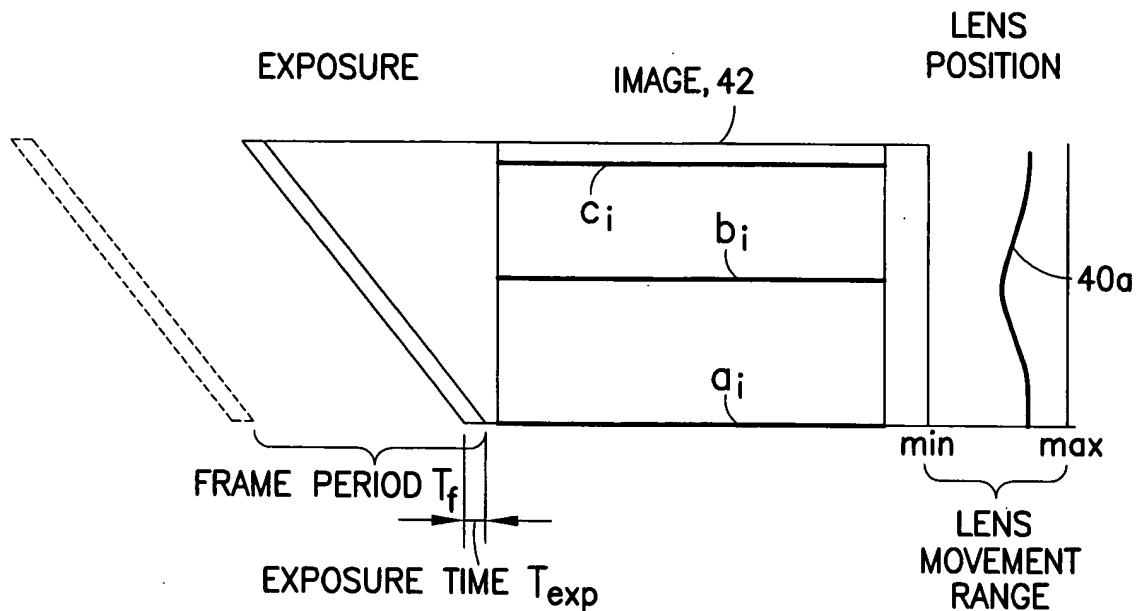


FIG. 9

6/8



FIG.10A

7/8

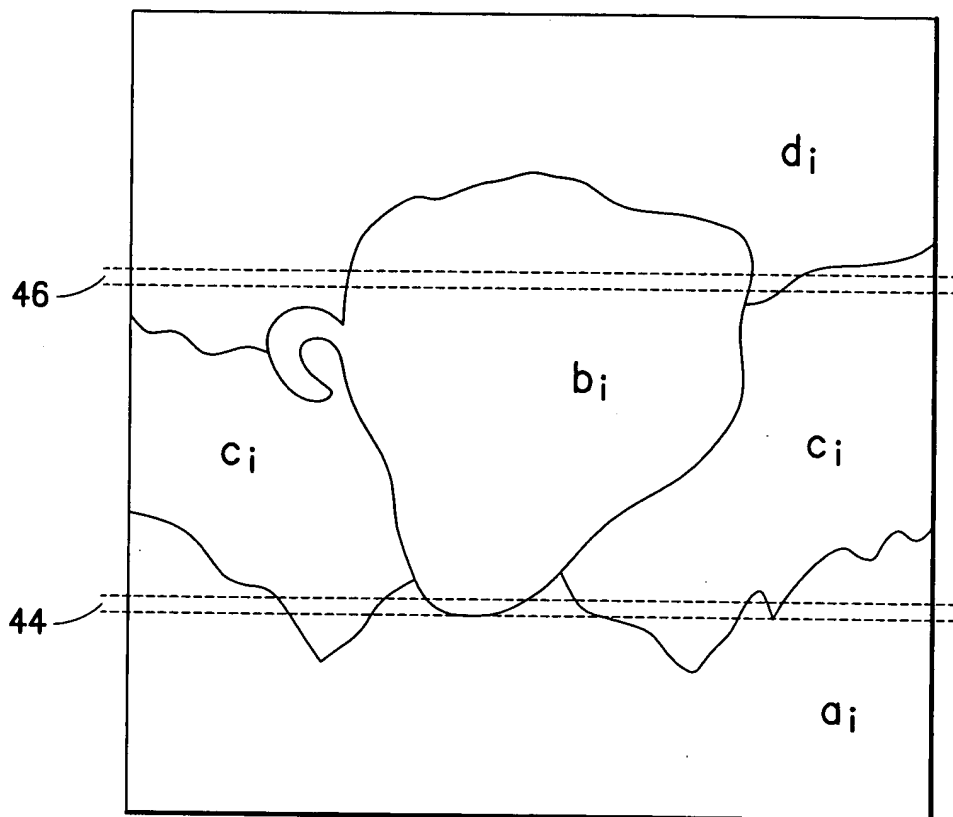


FIG. 10B

8/8

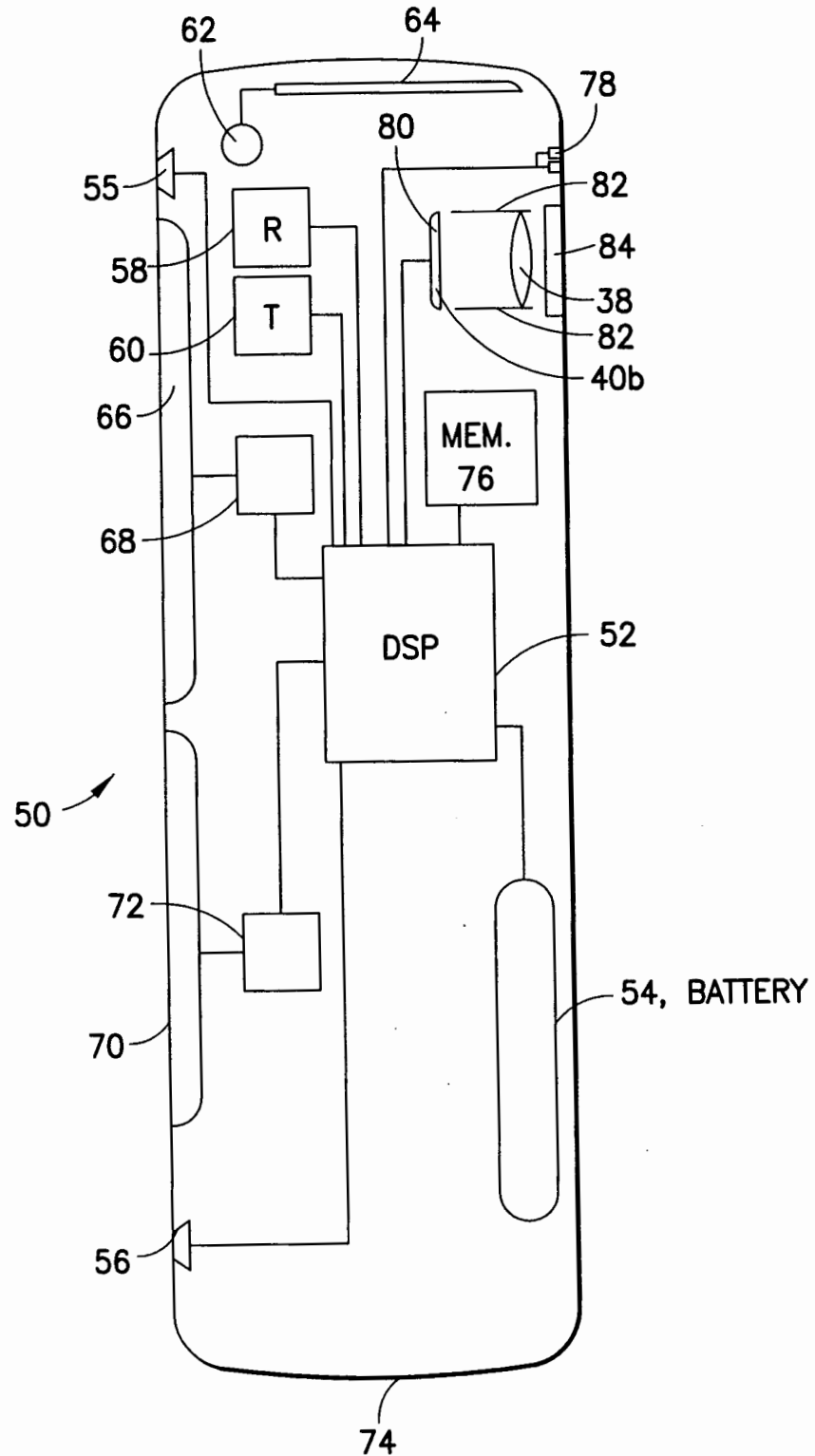


FIG.11

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Nokia Corporation Docket No.: NC48724
Harrington & Smith, LLP Docket No.: 877.0006.U1(US)

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter, which is claimed and for which a patent is sought on the invention entitled:

**ADAPTIVE OPTICAL PLANE FORMATION
WITH ROLLING SHUTTER**

the specification of which:

(check one) ☒ is attached hereto.

☐ was filed on _____ as U.S. Application Serial No. _____, and was amended on _____ (if applicable).

☐ was described and claimed in PCT International Application Number filed on _____ and

☐ as amended under PCT Article 19 on _____ (if any) and/or

☐ as amended under PCT Article 34 as published in the Annex(es) to the International Preliminary Examination Report (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to the patentability of this application as defined in Title 37, Code of Federal Regulations, §1.56

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate(s) listed below and have also identified below any foreign application(s) for patent or inventor's certificate(s) having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

(Number)

(Country)

(Day/Mon/Year Filed)

☐ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code, §119(e) of the United States provisional patent application(s) listed below:

(Application Serial No.) (Filing Date)

I hereby claim benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.) (Filing Date) (Status)

POWER OF ATTORNEY: As a named inventor I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the U.S. Patent and Trademark Office connected therewith:

Steven Shaw	39,368
Gary H. Savitt	44,351
Arjun Krishnan	55,347
Thomas R. Weber	41,547
Wayne DeMello	48,601

And all attorneys associated with Customer No.: **29,683**

SEND CORRESPONDENCE TO:

Customer No. 29,683

DIRECT TELEPHONE CALLS TO:

Harry F. Smith
Telephone: (203) 925-9400
Facsimile: (203) 944-0245

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

FULL NAME
OF INVENTOR

LAST NAME
Kakkori

FIRST NAME
Hannu

MIDDLE NAME

RESIDENCE
CITIZENSHIP

STATE OR COUNTRY
Tampere, Finland

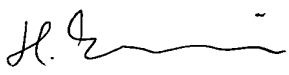
CITIZENSHIP
Finland

POST OFFICE
ADDRESS

P.O. ADDRESS

Hämeenpuisto 35 A 30, 33200 Tampere, Finland

CITY & COUNTRY

Signature 

Date June 27th 2005

ARTIFACT SHEET

Enter artifact number below. Artifact number is application number + artifact type code (see list below) + sequential letter (A, B, C ...). The first artifact folder for an artifact type receives the letter A, the second B, etc.. Examples: 59123456PA, 59123456PB, 59123456ZA, 59123456ZB

11165992CA

Indicate quantity of a single type of artifact received but not scanned. Create individual artifact folder/box and artifact number for each Artifact Type.

☐

CD(s) containing:

computer program listing

Doc Code: Computer

pages of specification

and/or sequence listing

and/or table

Doc Code: Artifact

content unspecified or combined

Doc Code: Artifact

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Artifact Type Code: S

☐

Artifact Type Code: U

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Bound Document(s)

Doc Code: Artifact Artifact Type Code: B

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Other, description: _____

Doc Code: Artifact Artifact Type Code: Z

IFW



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 11/165,992 Confirmation No.: 3430
Applicant(s): Hannu Kakkori
Filed: 06/24/2005
Art Unit: 2851
Examiner:
Title: Adaptive Optical Plane Formation With Rolling Shutter

Attorney Docket No.: 877.0006.U1(US)
Customer No.: 29,683

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

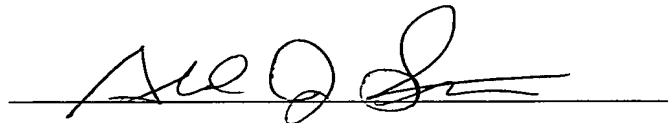
The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the documents listed on the enclosed Form PTO-1449. Copies of the non-US documents are enclosed with the Form PTO-1449 for the Examiner's use. The documents listed were cited in an International Search Report issued in the corresponding International Application (PCT/IB2006/001507). A copy of the Search Report is attached.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the

claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

Respectfully submitted,



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Nov 1, 2006

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Date


Lisa Mrozek

**INFORMATION DISCLOSURE
CITATION FORM FOR
PATENT APPLICATION
(FORM PTO-1449)
(Substitute)**

Docket No.: 877.0006.U1(US)


Serial No.: 11/165,992

Applicant(s): Hannu Kakkori

Filing Date: 06/24/2000

Group: 2851

U.S. PATENT DOCUMENTS

Examiner Initials	Document Number (Number-Kind Code)	Publication Date (MM-DD-YYYY)	Name of Patentee or Applicant	Class	Sub-class
	US-2004-0217257 A1	11-04-2004	Fiete et al.	250	201.7
	US-5,745,175	04-28-1998	Anderson	348	345
	US-				
	US-				
	US-				
	US-				
	US-				
	US-				
	US-				
	US-				
	US-				
	US-				
	US-				
	US-				

FOREIGN PATENT DOCUMENTS

Examiner Initials	Document Number (Country Code-Number-Kind Code)	Publication Date (MM-DD-YYYY)	Name Of Patentee of Applicant	Translation? Yes/No/n/a
	JP-2003-131115A	05-08-2003	Minolta Co Ltd	Abstract
	- -			
	- -			
	- -			
	- -			
	- -			

OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

Examiner's Signature:

Date Considered:

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered.
Include a copy of this citation form with your next correspondence to the Applicant(s).

DIGITAL CAMERA

Publication number: JP2003131115

Publication date: 2003-05-08

Inventor: KARASAKI TOSHIHIKO; NOBUYUKI NORIYUKI;
SHINKAWA KATSUHITO

Applicant: MINOLTA CO LTD

Classification:

- international: G03B7/095; G02B7/28; G03B13/36; H04N5/232;
H04N101/00; G03B7/091; G02B7/28; G03B13/36;
H04N5/232; (IPC1-7): G02B7/28; G03B7/095;
G03B13/36; H04N5/232; H04N101/00

- european:

Application number: JP20010322700 20011019

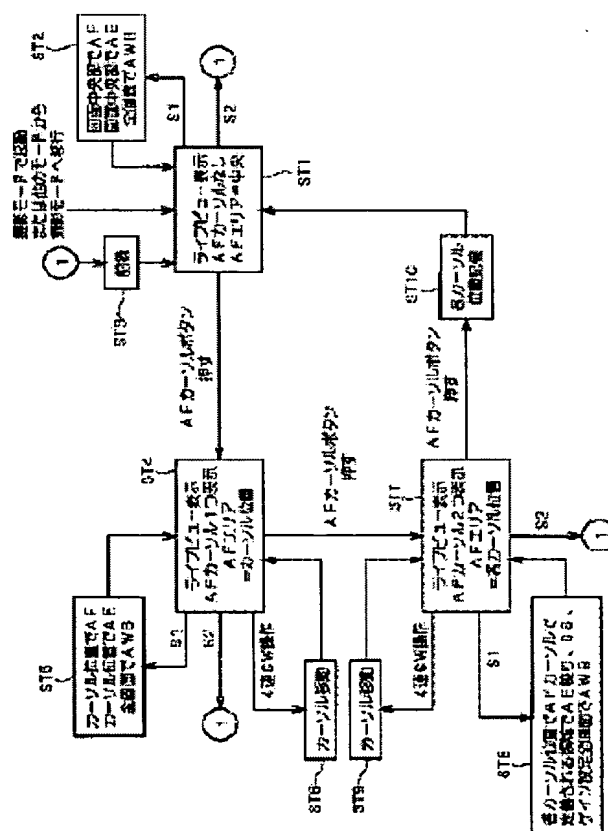
Priority number(s): JP20010322700 20011019

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Abstract of JP2003131115

PROBLEM TO BE SOLVED: To provide a digital camera capable of focusing on both objects at along distance and a close distance even in the case of photographing an image where the objects stand at the long distance and the close distance, attaining the focal state as a user intends, and then, photographing.

SOLUTION: When the user depresses the AF cursor button of the digital camera, the number of AF cursors displayed on an LCD increases. When a shutter button is depressed half in a state (S1) where two AF cursors are displayed on the LCD (ST7), an AF control is performed so that the object corresponding to the display position of each AF cursor may be in the focused state (ST8). At this time, in the case that several objects corresponding to respective AF cursors are not in the depth of field, the diaphragm of the photographing lens is stopped down, and the depth of field is increased. The focusing operation is performed while adjusting the depth of field so that several objects may be simultaneously made in the focused state.



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(19)日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開2003-131115

(P2003-131115A)

(43)公開日 平成15年5月8日(2003.5.8)

(51)Int.Cl. ⁷	識別記号	F I	テーマコード(参考) ¹
G 0 2 B 7/28		C 0 3 B 7/095	2 H 0 0 2
G 0 3 B 7/095		H 0 4 N 5/232	A 2 H 0 1 1
13/36		101:00	2 H 0 5 1
H 0 4 N 5/232		C 0 2 B 7/11	N 5 C 0 2 2
// H 0 4 N 101:00		C 0 3 B 3/00	A
		審査請求 有	請求項の数 5 O L (全 21 頁)

(21)出願番号 特願2001-322700(P2001-322700)

(22)出願日 平成13年10月19日(2001. 10. 19)

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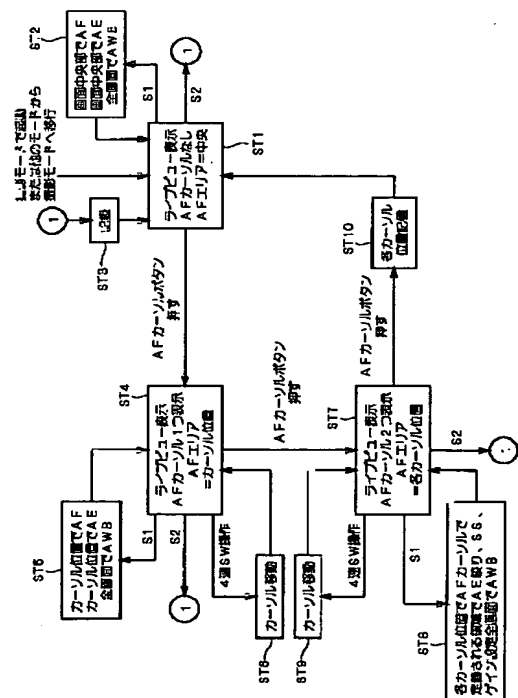
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(54)【発明の名称】 デジタルカメラ

(57)【要約】

【課題】 遠近競合する画像であっても、遠近双方の被写体を合焦させることができ、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことができるデジタルカメラを提供すること。

【解決手段】 ユーザがデジタルカメラのAFカーソルボタンを押下操作していくと、LCDに表示されるAFカーソルの数が増加する。AFカーソルがLCDに2個表示されている状態(状態ST7)で、シャッターボタンが半押し(S1)状態にされると、各AFカーソルの表示位置に対応する被写体が合焦状態となるようにAF制御される(状態ST8)。このとき、各AFカーソルに対応する複数の被写体が被写界深度に収まっていない場合には、撮影レンズの絞りが絞込まれて被写界深度が深くされる。被写界深度が調整されることによって、複数の被写体が同時に合焦状態となるような合焦動作が行われる。



【特許請求の範囲】

【請求項1】 被写体像の撮影を行うデジタルカメラであって、

撮影前の被写体像を表示可能な表示手段と、
操作入力に基づき、前記表示手段の画面において複数の合焦ポイントを指定する指定手段と、
前記指定手段によって指定された前記複数の合焦ポイントに対応する複数の画像部分が合焦状態となるように合焦動作を行う合焦手段と、を備えるデジタルカメラ。

【請求項2】 請求項1に記載のデジタルカメラにおいて、

前記指定手段は、
操作入力に応答して前記合焦ポイントの数を変化させるポイント数変更手段と、
前記画面における各合焦ポイントの位置を移動させるポイント移動手段と、を備えるデジタルカメラ。

【請求項3】 撮影レンズを介して被写体像の撮影を行うデジタルカメラであって、

撮影前の被写体像を表示可能な表示手段と、
操作入力に基づき、前記表示手段の画面において複数の合焦ポイントを指定する指定手段と、
前記指定手段によって指定された前記複数の合焦ポイントに基づいて、前記複数の合焦ポイントを含む合焦領域を設定する合焦領域設定手段と、
前記合焦領域に含まれる画像が合焦状態となるように、前記撮影レンズを駆動制御する制御手段と、を備えるデジタルカメラ。

【請求項4】 絞りを有する撮影レンズを介して被写体像の撮影を行うデジタルカメラであって、

撮影前の被写体像を表示可能な表示手段と、
操作入力に基づき、前記表示手段の画面において複数の合焦ポイントを指定する指定手段と、
前記指定手段によって指定された前記複数の合焦ポイントに基づいて、前記複数の合焦ポイントを含む合焦領域を設定する合焦領域設定手段と、
前記合焦領域に含まれる画像が合焦状態となるように、前記絞りを駆動制御する制御手段と、を備えるデジタルカメラ。

【請求項5】 撮像素子によって被写体像の撮影を行うデジタルカメラであって、

撮影前の被写体像を表示可能な表示手段と、
操作入力に基づき、前記表示手段の画面において複数の合焦ポイントを指定する指定手段と、
前記指定手段によって指定された前記複数の合焦ポイントに基づいて、前記複数の合焦ポイントを含む合焦領域を設定する合焦領域設定手段と、
前記合焦領域に含まれる画像が合焦状態となるように、前記撮像素子における撮影解像度を制御する制御手段と、を備えるデジタルカメラ。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】この発明は、被写体像を撮影するデジタルカメラに関し、特に、デジタルカメラにおける合焦技術に関する。

【0002】

【従来の技術】従来、デジタルカメラを用いて被写体像の撮影を行う際、ユーザが被写体像における合焦ポイントを指定することにより、その合焦ポイントに対応する画像部分が合焦状態となるように合焦制御を行うデジタルカメラが知られている。

【0003】

【発明が解決しようとする課題】しかしながら、従来のデジタルカメラでは、遠方にある被写体と近くある被写体とが混在するような場合、いずれか一方に合焦ポイントを合わせただけでは、双方の被写体を合焦状態に導くことは困難であった。

【0004】その反面、ユーザにしてみれば、遠方にある被写体と近くある被写体とが混在する場合でも遠近双方の被写体像を合焦状態として、撮影を行いたいと思う場合もある。

【0005】そこで、この発明は、上記課題に鑑みてなされたものであって、遠近競合する画像であっても、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことができるデジタルカメラを提供することを目的とする。

【0006】

【課題を解決するための手段】上記目的を達成するために、請求項1に記載の発明は、被写体像の撮影を行うデジタルカメラであって、撮影前の被写体像を表示可能な表示手段と、操作入力に基づき、前記表示手段の画面において複数の合焦ポイントを指定する指定手段と、前記指定手段によって指定された前記複数の合焦ポイントに対応する複数の画像部分が合焦状態となるように合焦動作を行う合焦手段と、を備えている。

【0007】請求項2に記載の発明は、請求項1に記載のデジタルカメラにおいて、前記指定手段が、操作入力に応答して前記合焦ポイントの数を変化させるポイント数変更手段と、前記画面における各合焦ポイントの位置を移動させるポイント移動手段と、を備えている。

【0008】請求項3に記載の発明は、撮影レンズを介して被写体像の撮影を行うデジタルカメラであって、撮影前の被写体像を表示可能な表示手段と、操作入力に基づき、前記表示手段の画面において複数の合焦ポイントを指定する指定手段と、前記指定手段によって指定された前記複数の合焦ポイントに基づいて、前記複数の合焦ポイントを含む合焦領域を設定する合焦領域設定手段と、前記合焦領域に含まれる画像が合焦状態となるように、前記撮影レンズを駆動制御する制御手段と、を備えている。

【0009】請求項4に記載の発明は、絞りを有する撮

影レンズを介して被写体像の撮影を行うデジタルカメラであって、撮影前の被写体像を表示可能な表示手段と、操作入力に基づき、前記表示手段の画面において複数の合焦ポイントを指定する指定手段と、前記指定手段によって指定された前記複数の合焦ポイントに基づいて、前記複数の合焦ポイントを含む合焦領域を設定する合焦領域設定手段と、前記合焦領域に含まれる画像が合焦状態となるように、前記絞りを駆動制御する制御手段と、を備えている。

【0010】請求項5に記載の発明は、撮像素子によって被写体像の撮影を行うデジタルカメラであって、撮影前の被写体像を表示可能な表示手段と、操作入力に基づき、前記表示手段の画面において複数の合焦ポイントを指定する指定手段と、前記指定手段によって指定された前記複数の合焦ポイントに基づいて、前記複数の合焦ポイントを含む合焦領域を設定する合焦領域設定手段と、前記合焦領域に含まれる画像が合焦状態となるように、前記撮像素子における撮影解像度を制御する制御手段と、を備えている。

【0011】

【発明の実施の形態】以下、この発明の実施の形態について図面を参照しつつ詳細に説明する。

【0012】＜1. デジタルカメラの構成＞図1ないし図4は、本発明の一の実施形態に係るデジタルカメラ1の正面図、背面図、側面図および底面図であり、図5はデジタルカメラ1の内部構成を示すブロック図である。

【0013】デジタルカメラ1は、図1に示すように、箱型のカメラ本体部2と直方体状の撮像部3（図1、図2および図4に太線で図示）とから構成されている。撮像部3は、ズームレンズ等で構成されるマクロ機能付きの撮影レンズ301を有するとともに、銀塩フィルムを用いるレンズシャッターカメラ（以下、「銀塩カメラ」と称する）と同様に、被写体からのフラッシュ光の反射光を受光する調光センサ305、および光学ファインダ31が設けられる。また、撮影レンズ301には、絞り値（Fナンバ）を可変させることの可能な絞り、撮影倍率を可変するためのズームレンズ、及び、被写体像の合焦状態を調整するためのレンズが含まれており、35mmフィルムを使用する銀塩カメラに換算して焦点距離35mmから70mmまでのズームが可能となっている。

【0014】なお、撮像部3内部には撮影レンズ301の後方位置に、撮像素子として機能するCCDカラーエリアセンサであるCCD303（図5参照）を有し、CCD303は撮像回路302の一部となっている。

【0015】カメラ本体部2の前面には、図1に示すように、左端部にグリップ部4および中央上部に内蔵フラッシュ5が設けられ、上面にはシャッターボタン8が設けられている。

【0016】一方、図2に示すように、カメラ本体部2の背面には、略中央に撮影画像のモニタ表示（ビューフ

ァインダに相当）、記録画像の再生表示等を行うためのLCD10が設けられている。このLCD10は、例えば400×300画素数の表示画面を有する表示手段である。また、LCD10の下方に、デジタルカメラ1の操作を行うキースイッチ群221～226および電源スイッチ227が設けられる。なお、キースイッチ224が拡大表示ボタンとして、キースイッチ225が、合焦ポイントに対応するAFカーソルをLCD10上に表示させるAFカーソルボタンとして、キースイッチ226がメニューボタンとして機能する。電源スイッチ227の左側には、電源がオン状態で点灯するLED228およびメモ리카ードへのアクセス中であることを表示するLED229が配置される。

【0017】さらに、カメラ本体部2の背面には、「撮影モード」、「再生モード」および「プリファレンスモード」の間でモードを切り替えるモード設定スイッチ14が設けられる（図3参照）。撮影モードは、写真撮影を行うモードであり、再生モードは、メモ리카ードに記録された撮影済み画像をLCD10に再生表示するモードであり、さらに、プリファレンスモードは、表示される表示項目（設定項目）の中から選択することにより各種の設定を行うモードである。

【0018】モード設定スイッチ14は、3接点のスライドスイッチであり、図2において下にセットすると撮影モードに設定され、中央にセットすると再生モードに設定され、上にセットするとプリファレンスモードに設定される。

【0019】また、カメラ背面右側には、4連スイッチ230が設けられ、撮影モードにおいてボタン231、232を押すことにより撮影レンズ301の焦点距離が変わり、ズーム倍率を変更するズーミングが行えるとともに、ボタン233、234を押すことによって露出補正を手動で行える。また、撮影モード下であっても、AFカーソルボタンとして機能するキースイッチ225の押下操作が行われた場合には、4連スイッチ230の各ボタン231～234がAFカーソルを移動させるための操作ボタンとなる。

【0020】撮像部3の背面には、図2に示すように、LCD10をオン／オフさせるためのLCDボタン321およびマクロボタン322が設けられる。LCDボタンが押されるとLCD表示のオン／オフが切り替わる。例えば、専ら光学ファインダ31のみを用いて撮影するときには、節電の目的でLCD表示をオフにする。マクロ撮影時には、マクロボタン322が押されることにより、AFモータ308（図5参照）が駆動され撮影レンズ301がマクロ撮影可能な状態になる。

【0021】カメラ本体部2の側面には、図3に示すようにDC入力端子235が設けられる。

【0022】カメラ本体部2の底面には、図4に示すように、電池装填室18と、カード装填室17（カードス

ロット部)とが設けられる。カード装填室17は、メモリカード91やモデムカード92などが装填できる。このカード装填室17については、ラムシェルタイプの蓋15により開閉自在になっている。

【0023】デジタルカメラ1では、4本の単三形乾電池を電池装填室18に装填することにより、これらを直列接続してなる電源電池236(図5参照)を駆動源としている。もちろん、図4に示すDC入力端子235からアダプタからの電力を供給して使用することも可能である。

【0024】次に、図5を参照しながら撮像部3の内部構成について順に説明する。

【0025】撮像回路302は、撮影レンズ301によりCCD303上に結像された被写体の光像を、CCD303を用いて光電変換し、R(赤)、G(緑)、B(青)の色成分の画像信号(各画素で受光された画素信号の信号列からなる信号)として出力する。CCD303は、その撮像面に例えば1600×1200の画素を有している。

【0026】デジタルカメラ1では絞りが可変絞りとなっているので、撮像部3における露出制御は、所定のプログラムラインに沿って、絞り値とシャッタースピード(CCD303の電荷蓄積時間)とを調整することにより行われる。また、被写体輝度が低輝度である場合であって適切な絞り値及びシャッタースピードを設定することができない場合には、CCD303から出力される画像信号のレベル調整を行うことにより露光不足による不適正露出が補正される。画像信号のレベル調整は、信号処理回路313内のAGC(オートゲインコントロール)回路によって行われる。

【0027】タイミングジェネレータ314は、カメラ本体部2内のタイミング制御回路202から送信されるクロックに基づきCCD303の駆動制御信号を生成するものである。タイミングジェネレータ314は、例えば、積分開始/終了(すなわち、電荷蓄積の開始/終了)のタイミング信号、各画素の受光信号の読出制御信号(水平同期信号、垂直同期信号、転送信号等)等のクロック信号を生成し、CCD303に出力する。

【0028】信号処理回路313は、撮像回路302から出力される画像信号(アナログ信号)に所定のアナログ信号処理を施すものである。信号処理回路313は図示しないが、その内部にCDS(相関二重サンプリング)回路とAGC回路とを有し、CDS回路により画像信号のノイズの低減を行い、AGC回路のゲインを調整することにより画像信号のレベル調整を行う。なお、AGC回路におけるゲイン設定は、カメラ本体部2の全体制御部211によって行われる。

【0029】調光回路304は、フラッシュ撮影における内蔵フラッシュ5の発光量をカメラ本体部2の全体制御部211により設定された所定の発光量に制御するも

のである。フラッシュ撮影においては、CCD303の積分開始と同時に被写体からのフラッシュ光の反射光が調光センサ305により受光され、この受光量が所定の発光量に達すると、調光回路304から全体制御部211を介してカメラ本体部2のフラッシュ制御回路214へ発光停止信号が出力される。フラッシュ制御回路214は、この発光停止信号に応答して内蔵フラッシュ5の発光を強制的に停止し、これにより、内蔵フラッシュ5の発光量が所定の発光量に制御される。

【0030】また、撮像部3の内部には、撮影レンズ301のズーム比の変更と収容位置と撮影位置との間のレンズ移動を行うためのズームモータ307、合焦を行うためのAF(オートフォーカス)モータ308、及び、絞りの開放状態を調整するための絞りモータ309が設けられる。

【0031】次に、カメラ本体部2の内部構成について説明する。

【0032】全体制御部211は主にCPUからなり、アドレスバス、データバス、コントロールバスで接続されている上述した撮像部3内およびカメラ本体部2内の各周辺構成の駆動を制御することによってデジタルカメラ1の撮影動作を統括制御するものである。また、全体制御部211内には、データを一時的に記憶するためのワークRAMとして機能するDRAM211a、およびプログラムを格納するためのフラッシュROM211bを内蔵している。

【0033】次に、カメラ本体部2の内部における画像信号の処理および画像表示に関する構成について説明する。

【0034】撮像部3の信号処理回路313から送られたアナログ画像信号はカメラ本体部2内の画像処理部200において各種画像処理が施される。図6は画像処理部200の構成を示すブロック図である。まず、画像処理部200へ送られてきたアナログ画像信号はA/D変換器205において各画素ごとに10ビットのデジタル信号に変換される。A/D変換器205は、タイミング制御回路202から入力されるA/D変換用のクロックに基づいて各画素信号(アナログ信号)を10ビットのデジタル信号に変換する。

【0035】なお、タイミング制御回路202は、全体制御部211の制御により、基準クロックやタイミングジェネレータ314およびA/D変換器205に対するクロックを生成する。

【0036】黒レベル補正回路206は、A/D変換された画素信号(以下、「画素データ」という。)の黒レベルを基準の黒レベルに補正するものである。また、WB(ホワイトバランス)回路207は、R、G、Bの各色成分の画素データのレベル変換を行うものであり、後工程のγ補正を考慮したホワイトバランスの自動調整(AWB)を行う。ホワイトバランスの調整は、全体制御

部211からWB回路207に入力されるレベル変換テーブルを用いて行われ、レベル変換テーブルの各色成分の変換係数(特性の傾き)は全体制御部211により撮影画像毎に設定される。

【0037】 γ 補正回路208は、画素データの γ 特性を補正するものである。 γ 補正回路208からの出力は図5に示すように画像メモリ209に送られる。

【0038】画像メモリ209は、画像処理部200から出力される画素データを記憶するメモリであり、1フレーム分の記憶容量を有している。すなわち、画像メモリ209は、CCD303が1600×1200のマトリクス状に配列した画素を有している場合、1600×1200画素分の画素データの記憶容量を有し、各画素データが対応する記憶領域(アドレス)に記憶されるようになっている。

【0039】VRAM210は、LCD10に再生表示される画像データのバッファメモリである。VRAM210は、LCD10の400×300画素に対応した画像データの記憶容量、すなわち400×300画素分の容量を有している。

【0040】このような構成により、撮影モードにおける撮影待機状態においては、撮像部3により所定間隔毎に撮像された画像の各画素データが画像処理部200により処理され、画像メモリ209に記憶されるとともに全体制御部211を介してVRAM210に転送され、LCD10に表示される。これにより、被写体に関する撮影前の画像をLCD10に動的に表示するライブビュー表示が行えることとなる。

【0041】すなわち、ライブビュー表示では、図7に示すように、1600×1200画素の画像メモリ209内の画像データを、縦横1/4に間引いて400×300画素のVRAM210に転送されることとなる。

【0042】また、再生モードにおいては、メモリカード91から読み出された画像に全体制御部211による所定の信号処理が施された後、VRAM210に転送されてLCD10に再生表示される。なお、LCD10において画像を表示する際には、全体制御部211の制御によりバックライト16が点灯する。

【0043】次に、カメラ本体部2内のその他の構成について順に説明する。

【0044】カードI/F212は、カード装填室17に装填された各種の機能カードとの間で信号の受け渡しを行うインタフェースである。機能カードとは、メモリカード91やモデムカード92等であり、カードI/F212は、全体制御部211からの指令に基づいて、メモリカード91の画像データの書き込みおよび画像データの読出しを行ったり、モデムカード92を介してデジタルカメラ1の外部とデータ入出力を行う。

【0045】フラッシュ制御回路214は、前述のように、内蔵フラッシュ5の発光を制御する回路である。フ

ラッシュ制御回路214は、全体制御部211の制御信号に基づき内蔵フラッシュ5の発光の有無、発光量および発光タイミング等を制御し、調光回路304から入力される発光停止信号に基づき内蔵フラッシュ5の発光量を制御する。

【0046】時計回路219は、撮影日時を管理するための時計回路である。図示しない別の電源で駆動される。

【0047】また、カメラ本体部2内には、ズームモータ307を駆動するためのズームモータ駆動回路215、AFモータ308を駆動するためのAFモータ駆動回路216、絞りモータ309を駆動するための絞りモータ駆動回路217が設けられる。これらの回路は、全体制御部211の制御によって動作するように構成される。また、全体制御部211は、ユーザがシャッターボタン8やその他の上述した各種スイッチ、ボタンである操作部250の操作を行った際に、その操作に応じて、各駆動回路215～217を制御して、CCD303に結像される被写体像がユーザの意図通りの画像となるように制御する。

【0048】例えば、シャッターボタン8は銀塩カメラで採用されているような半押し状態(S1)と全押し状態(S2)とが検出可能な2段階スイッチになっており、撮影モード時の待機状態でユーザがシャッターボタン8を半押し状態にすると、AFモータ駆動回路216がAFモータ308を駆動し、合焦位置へ撮影レンズ301を移動させる。このときの合焦動作は、ユーザによって指定される合焦ポイント(すなわちAFカーソル)の位置に対応する画像部分が合焦状態となるように行われる。なお、AFカーソルの位置はユーザの操作によって移動可能のように構成され、かつ、AFカーソルの数もユーザの操作によって変化するように構成される。

【0049】全体制御部211は、ユーザがAFカーソルボタン(キースイッチ225:図2参照)を操作した際に、LCD10に表示するライブビュー表示に重畳させた状態で、AFカーソルを表示させる。そしてユーザが4連スイッチ230の各ボタン231～234を操作した場合に、全体制御部211は、その操作にตอบสนองしてLCD10に表示するAFカーソルを画面内で移動させる。

【0050】そしてAFカーソルが複数個設定された場合には、全体制御部211は合焦動作を行う際に、それら複数のAFカーソルが位置する画像部分が同時に合焦状態となるような合焦制御を行う。

【0051】<2.自動合焦制御>次に、デジタルカメラ1における自動合焦制御について詳細に説明する。図8は、画像における合焦状態を評価するAF評価ブロックを示す図である。図8(a)に示すように、1600×1200の画素で構成される画像データは、水平方向に8分割、垂直方向に15分割されて形成される各プロ

ックがAF評価ブロックとなる。つまり、図8(b)に示すように、1個のAF評価ブロックは200×80画素によって構成される。

【0052】なお、上記の8分割されて形成される水平方向のAF評価ブロックの配列に対し、互いに隣接するAF評価ブロックの水平方向について半分の領域が重なるように、さらに7×15個のAF評価ブロックを設けるようにしてもよい。このように構成すれば、AF評価ブロックは水平方向に15個及び垂直方向に15個配列されることとなり、画像における合焦ポイントの位置を微細に調整することが可能になる。

【0053】デジタルカメラ1では、上記のAF評価ブロックに対応するAFカーソルがLCD10に表示されることとなるが、これに関して以下で説明する。

【0054】図9は、デジタルカメラ1の部分ブロック図である。また、図10は、LCD10におけるAFカーソルの表示状態を示す図である。

【0055】全体制御部211は、カーソル発生部211fと、カーソル表示位置制御部211gと、解像度交換部211hと、画像合成部211iと、合焦領域設定部211jと、評価値演算部211kとを有している。

【0056】カーソル発生部211fは、LCD10において、図10に示すAFカーソルCR1、CR2を発生させるためのカーソルデータをフラッシュROM211bから読出し、カーソル表示位置制御部211gに転送する。なお、AFカーソルCR1、CR2は、十字の形状を有し、そのサイズは、LCD10の画面上で16×16画素の大きさとなっている。なお、後述する合焦ポイントの優先設定を行う際には、CR1、CR2と識別可能にするために、色もしくは形状を区別する。あるいはカーソルの様に記号等を表示するのが望ましい。

【0057】また、カーソル発生部211fは、AFカーソルCR1、CR2の一方を警告表示に切り換える際にも、警告表示に対応するカーソルデータをフラッシュROM211bから読出し、カーソル表示位置制御部211gに転送する。なお、AFカーソルの警告表示については後述する。

【0058】カーソル表示位置制御部211gは、操作部250に対してユーザによって行われる操作入力に基づき、LCD10上のAFカーソルCR1、CR2の表示位置を変更する。カーソル表示位置制御部211gは、AFカーソルCR1、CR2が画像データに設定される各AF評価ブロックの位置に対応して移動するように表示位置の制御を行うように構成される。このため、AF評価ブロックが水平方向に8個設けられている場合、AFカーソルCR1、CR2は、ユーザの操作にตอบสนองして水平方向に8箇所、垂直方向に15箇所の任意の位置に移動することができる。また、AF評価ブロックが水平方向に15個設けられている場合、AFカーソルCR1、CR2は、ユーザの操作にตอบสนองして水平方向に

15箇所、垂直方向に15箇所の任意の位置に移動することができる。

【0059】より具体的には、ユーザが4連スイッチ230の左側ボタン231(図2参照)を1回操作すると、LCD10に表示されるAFカーソルCR1又はCR2がAF評価ブロックの配列に応じて1段階左方側に移動し、右側ボタン232を1回操作すると1段階右方側に移動する。同様に、上側ボタン233を1回操作すると1段階上方側に移動し、下側ボタン234を1回操作すると1段階下方側に移動する。

【0060】また、カーソル表示位置制御部211gは、LCD10の画面上に表示するAFカーソルCR1、CR2の数も制御する。

【0061】例えば、初期状態においてLCD10の画面上にはAFカーソルは表示せず、画像の中央部分に対応するAF評価ブロックの画像成分が合焦状態となるように設定される。そして、ユーザがAFカーソルボタン(キースイッチ225:図2参照)を操作した際に、LCD10に表示するライブビュー表示に重畳させた状態で、第1のAFカーソルCR1を表示させる。このときAFカーソルCR1の表示位置は、初期位置、例えば画面中央部のAF評価ブロックに対応する位置となる。そして、ユーザが4連スイッチ230の各ボタン231～234を操作することにより、初期位置に表示される第1のAFカーソルCR1を、合焦状態を実現したい画像部分に移動させる。

【0062】この状態でユーザがシャッターボタン8を半押し状態(S1)にした場合、第1のAFカーソルCR1の位置に対応するAF評価ブロックBK1の画像成分が合焦状態となるように合焦制御が行われる。

【0063】一方、ユーザがシャッターボタン8を操作することなく、さらにAFカーソルボタンを操作した場合、カーソル表示位置制御部211gは、第1のAFカーソルCR1を画面内に表示した状態で固定し、第2のAFカーソルCR2をさらにライブビュー表示に重畳させた状態で表示させる。このときもAFカーソルCR2の表示位置は初期位置となる。そして、ユーザが4連スイッチ230の各ボタン231～234を操作することにより、初期位置に表示される第2のAFカーソルCR2を、合焦状態を実現したい画像部分に移動させる。

【0064】この状態でユーザがシャッターボタン8を半押し状態(S1)にした場合、第1及び第2のAFカーソルCR1、CR2の位置に対応するAF評価ブロックBK1、BK2の画像成分が合焦状態となるように合焦制御が行われる。

【0065】そしてさらに、ユーザがシャッターボタン8を操作することなく、さらにAFカーソルボタンを操作した場合には、カーソル表示位置制御部211gは第1及び第2のAFカーソルCR1、CR2の画面上における現在位置をDRAM211a内に格納保存するととも

に、LCD10の画面上におけるAFカーソルCR1、CR2を表示しない状態に切り換える。

【0066】次に、解像度変換部211hは、CCD303で取得される画像データを1/4に間引いた画像を生成し、その画像を画像合成部211iに与えるように構成される。

【0067】画像合成部211iでは、解像度変換部211hから入力される画像と、カーソル表示位置制御部211gから入力されるAFカーソルCR1、CR2の画像とを合成し、VRAM210に伝送する。この合成動作により、LCD10上のAFカーソルCR1、CR2の大きさは、一定のサイズとなる。

【0068】合焦領域設定部211jは、LCD10の画面におけるAFカーソルCR1、CR2に対応し、合焦に利用する合焦領域（AFエリア）を設定する。合焦領域とは、合焦動作の際に評価値演算を行う対象となる画像領域である。

【0069】LCD10の画面上にAFカーソルCR1、CR2が表示されていない場合には、合焦領域設定部211jは、画像の中央部分に対応するAF評価ブロックを合焦領域として設定する。また、LCD10の画面上に第1のAFカーソルCR1のみが表示されている場合には、合焦領域設定部211jは、AFカーソルCR1の位置に対応するAF評価ブロックBK1を合焦領域として設定する。

【0070】また、LCD10の画面上に第1及び第2のAFカーソルCR1、CR2が表示されている場合、合焦領域設定部211jが合焦領域を設定する形態には2つの形態がある。第1の合焦領域設定形態は、AFカーソルCR1、CR2に対応するAF評価ブロックBK1、BK2を合焦領域として設定する形態であり、AFカーソルCR1、CR2の位置に対応しないAF評価ブロックについては合焦領域として用いられない。また、第2の合焦領域設定形態は、AFカーソルCR1、CR2に対応するAF評価ブロックBK1、BK2を含み、かつAFカーソルCR1、CR2の位置関係によって定まる評価領域に含まれる全てのAF評価ブロックを合焦領域として設定する形態である。

【0071】なお、第1の合焦領域設定形態と、第2の合焦領域設定形態とのいずれを適用するかは、プリファレンスモード下において、ユーザにより予め設定されるものとする。

【0072】評価値演算部211kは、シャッターボタン8が半押し状態(S1)になった場合に、コントラスト方式のAFを行うための評価値演算動作が行われる。ここでは、撮影レンズ301に含まれる合焦状態を調整するためのレンズを段階的に移動させつつ、合焦領域に含まれるAF評価ブロックごとに、各AF評価ブロックの画像成分に基づき、隣接画素間での画素データの差分絶対値の総和が評価値として求められる。このようにして求

められる評価値は、レンズ位置に応じて変化し、AF評価ブロックの画像成分が合焦状態となったときに最大値を示す。したがって、評価値が最大値を示すレンズ位置から、当該AF評価ブロックに含まれる被写体とデジタルカメラ1との距離（被写体距離）を一義的に求めることが可能である。

【0073】LCD10の画面上にAFカーソルが表示されていない場合には、評価値演算部211kが画像中央部分に対応する1個のAF評価ブロックについて評価値を求め、全体制御部211が評価値の最大値を示すレンズ位置に撮影レンズを移動させるべく、AFモータ駆動回路216を駆動制御すればよい。また、LCD10の画面上に第1のAFカーソルCR1だけが表示されている場合にも、評価値演算部211kがAFカーソルCR1の位置に対応する1個のAF評価ブロックについて評価値を求め、全体制御部211が評価値の最大値を示すレンズ位置に撮影レンズを移動させるべく、AFモータ駆動回路216を駆動制御すればよい。

【0074】一方、LCD10の画面上に第1及び第2のAFカーソルCR1、CR2が表示されている場合には、評価値演算部211kが、第1のAFカーソルCR1の位置に対応するAF評価ブロックBK1、及び、第2のAFカーソルCR2の位置に対応するAF評価ブロックBK2について評価値を求め、これらの評価値が最大値を示すレンズ位置からAF評価ブロックBK1、BK2に含まれるそれぞれの被写体までの被写体距離を求める。全体制御部211は、少なくともAF評価ブロックBK1、BK2に含まれるそれぞれの被写体が被写界深度内に収まるように制御する。

【0075】例えば、図10に示すようにAFカーソルCR1、CR2が設定されている場合において、ユーザがシャッターボタン8を半押し状態(S1)に操作すると、評価値演算部211kはAF評価ブロックBK1、BK2のそれぞれに含まれる画像成分から評価値を算出する。

【0076】図11は、AF評価ブロックBK1、BK2から算出される評価値C1、C2を示す図である。図11に示すように、AF評価ブロックBK1から求められる評価値C1は、レンズ位置P1で最大値を示す。また、AF評価ブロックBK2から求められる評価値C2は、レンズ位置P2で最大値を示す。そして、これらのレンズ位置P1、P2に基づいて、各AF評価ブロックBK1、BK2に含まれる被写体に関する被写体距離を求める。

【0077】図12は、評価値C1、C2に基づいて求められる被写体距離La、Lbを示す図である。図12に示すように、AF評価ブロックBK1に関する評価値C1から被写体81とデジタルカメラ1との被写体距離Laが求められる。また、AF評価ブロックBK2に関する評価値C2から被写体82とデジタルカメラ1との

被写体距離 L_b が求められる。

【0078】したがって、被写体距離 L_a にある被写体81と、被写体距離 L_b にある被写体82とを同時に合焦状態とするためには、被写体距離 L_a と被写体距離 L_b とが共に被写界深度内に収まる必要がある。

【0079】図13及び図14は、被写界深度の変化の一例を説明する図である。ここで、撮影レンズ301の絞り値(Fナンバ)をF、撮影レンズ301の焦点距離をf、CCD303の画素ピッチをd、許容錯乱円に基づく係数をkとし、撮影レンズ301を距離wの位置に合焦させたとき、撮影レンズ301から距離 L_1 から距離 L_2 までの間にある被写体は合焦状態となる。すなわち、距離 L_1 から距離 L_2 までの深さが被写界深度となり、距離 L_1 及び距離 L_2 は被写界深度の両端位置を示すことになる。

【0080】距離 L_1 は、

【0081】

【数1】

$$L_1 = \frac{wf^2}{f^2 + kFd(w-f)}$$

【0082】によって求められ、距離 L_2 は、

【0083】

【数2】

$$L_2 = \frac{wf^2}{f^2 - kFd(w-f)}$$

【0084】によって求められる。ここで、撮影レンズ301の絞りの開放径(絞り径)をDとすると、絞り値Fは $F=f/D$ によって定義される。

【0085】そして、撮影レンズ301の絞りを図13に示す開放径Dから図14に示す開放径 D_1 ($D_1 < D$)に変化させると、上記数1及び数2の式より、距離 L_1 の値は小さくなる一方、距離 L_2 の値は大きくなる。つまり、撮影レンズ301の絞りの開放径を小さくして、絞りを絞り込むことにより、被写界深度を深くすることができる。

【0086】したがって、図12に示すように被写体距離 L_a にある被写体81と、被写体距離 L_b にある被写体82とを同時に合焦状態にするためには、被写界深度の両端までの距離 L_1 、 L_2 を考えると、 $L_1 \leq L_a$ 及び $L_2 \geq L_b$ の関係が成立するように、全体制御部211は撮影レンズ301を制御する。

【0087】なお、全体制御部211が撮影レンズ301を制御することには、AFモータ駆動回路216に駆動信号を与えることによってAFモータ308を駆動し、それによって被写界深度の中心位置までの距離wを調整することと、絞りモータ駆動回路217に駆動信号を与えることによって絞りモータ309を駆動し、それによって被写界深度の深さを調整することとが含まれ

る。

【0088】また、全体制御部211はCCD303による撮影解像度を制御することによっても被写界深度の調整を行うように構成される。例えば、撮影解像度を低下させれば、画素ピッチdが大きくなるので、距離 L_1 の値を小さく、かつ、距離 L_2 の値を大きくすることができ、その結果、被写界深度を深くすることが可能である。

【0089】次に、デジタルカメラ1の動作を説明する。図15は、デジタルカメラ1の基本的な動作を示す状態遷移図である。

【0090】撮影モードに入ると、状態ST1となる。状態ST1では、LCD10でライブビュー表示が行われるとともに、AFカーソルCRが表示されず、LCD10の画面の中央に対応するAF評価ブロックが合焦領域(AFエリア)として設定される。ここで、シャッターボタン8が半押し(S1)されると、状態ST2に移行し、シャッターボタン8が全押し(S2)されると、状態ST3に移行する。

【0091】状態ST2では、LCD10の画面中央部(すなわち、画像の中央部)のAF評価ブロックについて合焦制御(AF)が行われる。また、AE(自動露光処理)についても画面中央部のAF評価ブロックの画像成分に基づいて行われ、AWB(オートホワイトバランス処理)については全画面の画像(すなわち撮影画像全体)に対して行われる。そして、シャッターボタン8が半押し(S1)状態から解除された場合には、状態ST1に戻る。

【0092】状態ST3では、全体制御部211が画像記録のための本撮影動作を行うように各部を制御し、CCD303による本撮影で得られた画像データがメモ리카ード91に記録される。

【0093】また、状態ST1において、AFカーソルボタンが押されると、状態ST4に移行する。状態ST4では、LCD10でライブビュー表示が行われるとともに、第1のAFカーソルCR1がLCD10の画面上に表示される。状態ST1から状態ST4への移行時において、DRAM211a内に、第1のAFカーソルCR1についての位置情報が格納されている場合には、それを読み出して、その位置情報に基づく画面上の位置に第1のAFカーソルCR1を表示する。ただし、DRAM211a内に第1のAFカーソルCR1についての位置情報が格納されていない場合には、初期状態となる画面中央の位置に第1のAFカーソルCR1を表示する。状態ST4において、シャッターボタン8が半押し(S1)されると、状態ST5に移行し、シャッターボタン8が全押し(S2)されると、状態ST3に移行する。また、4連スイッチ230が操作されると、状態ST6に移行する。

【0094】状態ST5では、LCD10に表示される

第1のAFカーソルCR1のカーソル位置に対応するAF評価ブロックBK1について合焦制御（AF）が行われる。また、AE（自動露光処理）についても第1のAFカーソルCR1に対応するAF評価ブロックBK1の画像成分に基づいて行われ、AWB（オートホワイトバランス処理）については全画面の画像（すなわち撮影画像全体）に対して行われる。そして、シャッターボタン8が半押し（S1）状態から解除された場合には、状態ST4に戻る。

【0095】状態ST6では、撮影者による4連スイッチ230の操作入力により、第1のAFカーソルCR1がLCD10の画面上で水平・垂直方向に移動し、第1の合焦ポイントが変更される。ここで、4連スイッチ230の操作に応じた第1のAFカーソルCR1の表示位置を移動させる処理が終了すると、再度状態ST4に移行する。そして状態ST4において再びAFカーソルボタンが押されると、第1のAFカーソルCR1の表示状態を維持したまま、状態ST7に移行する。

【0096】状態ST7では、LCD10でライブビュー表示が行われるとともに、第1のAFカーソルCR1が表示されているLCD10の画面上に、さらに第2のAFカーソルCR2が表示される。状態ST4から状態ST7への移行時において、DRAM211a内に、第2のAFカーソルCR2についての位置情報が格納されている場合には、それを読み出して、その位置情報に基づく画面上の位置に第2のAFカーソルCR2を表示する。ただし、DRAM211a内に第2のAFカーソルCR2についての位置情報が格納されていない場合には、初期状態となる画面中央の位置に第2のAFカーソルCR2を表示する。

【0097】状態ST7において、シャッターボタン8が半押し（S1）されると、状態ST8に移行し、シャッターボタン8が全押し（S2）されると、状態ST3に移行する。また、4連スイッチ230が操作されると、状態ST9に移行する。

【0098】状態ST8では、LCD10に表示される第1のAFカーソルCR1のカーソル位置に対応するAF評価ブロックBK1、及び、第2のAFカーソルCR2のカーソル位置に対応するAF評価ブロックBK2について合焦制御（AF）が行われる。つまり、AF評価ブロックBK1、BK2が同時に合焦状態となるように合焦制御が行われるのである。また、AE（自動露光処理）については、第1のAFカーソルCR1に対応するAF評価ブロックBK1と、第2のAFカーソルCR2に対応するAF評価ブロックBK2とによって定義される画像領域の画像成分に基づいて行われ、AWB（オートホワイトバランス処理）については全画面の画像（すなわち撮影画像全体）に対して行われる。

【0099】そして、状態ST8では、AF評価ブロックBK1、BK2が同時に合焦状態となるように合焦制

御が行われるため、絞り、シャッタースピード、又は、AGC回路のゲイン等が全体制御部211によって調整され、各AF評価ブロックBK1、BK2に含まれる被写体が同時に被写界深度内に収まるような合焦動作が行われる。なお、シャッタースピード又はAGC回路のゲインを調整するのは、絞りの開放径を調整して被写界深度を調整したことにより、露出レベルが変化することを防止するためであり、絞りの開放径の調整量に応じてシャッタースピードやゲインが設定される。

【0100】状態ST8で、シャッターボタン8が半押し（S1）状態から解除された場合には、再び状態ST7に戻る。

【0101】状態ST9では、撮影者による4連スイッチ230の操作入力により、第2のAFカーソルCR2がLCD10の画面上で水平・垂直方向に移動し、第2の合焦ポイントが変更される。ここで、4連スイッチ230の操作に応じた第2のAFカーソルCR2の表示位置を移動させる処理が終了すると、再び状態ST7に移行する。

【0102】そして状態ST7において再びAFカーソルボタンが押されると、状態ST10に移行する。状態ST10では、第1のAFカーソルCR1の表示位置、及び、第2のAFカーソルCR2の表示位置をDRAM211aに記憶する。そして、各AFカーソルCR1、CR2のカーソル位置の記憶処理が終了すると、LCD10の画面上から、AFカーソルCR1、CR2のカーソル表示を消去し、通常のライブビュー表示だけを表示するようにLCD10の表示状態を変更する。そして、その後、状態ST10から状態ST1に移行する。

【0103】このように、デジタルカメラ1では、ユーザがAFカーソルボタンの押下操作するごとにLCD10に表示されるAFカーソルの数が増加するように構成され、かつ、ユーザがAFカーソルボタンを所定回数押下した時点で、再びLCD10の画面上からAFカーソルの表示が消えるように構成される。そして、AFカーソルを増加させたときに、新たに画面上に表示されたAFカーソルの位置を4連スイッチ230を操作することによってAFカーソルの位置（すなわち合焦ポイント）を移動させることができるように構成されている。

【0104】したがって、ユーザは画面上に表示される複数のAFカーソルのうち、いずれが移動対象となっているかを容易に把握することができ、AFカーソルなどの指定において利便性が向上することとなる。

【0105】次に、複数のAFカーソル位置に対応する複数のAF評価ブロックを同時に合焦状態とするための各種処理について説明する。図16及び図17は、プリファレンスモード時における合焦領域の設定形態（合焦動作モード）を予め設定する際のLCD10における表示画面を示す図である。

【0106】まず、図16に示すように合焦動作モード

の設定画面がLCD10に表示され、ユーザは、ボタン233、234等进行操作することにより、上述した第1の合焦領域設定形態（合焦ポイントでの合焦制御を行うモード）と、第2の合焦領域設定形態（評価領域での合焦制御を行うモード）とのいずれか一方を選択する。なお、図16では選択された合焦モードを黒塗りで示している。

【0107】ところが、ユーザによって指定される複数のAFカーソルに対応する合焦ポイントの全てで絞り等を調整することで合焦状態を実現することが困難な場合もある。例えば、無限遠方の被写体と、デジタルカメラから数十cmのところにある近側被写体とを同時に合焦状態とすることは困難である。

【0108】そのため、プリファレンスモード時には、複数の合焦ポイントで合焦状態を実現することが困難な場合に、いずれの合焦ポイントを優先させて合焦制御を行うかを予め設定しておくことができるように構成されている。つまり、図16の設定画面に表示される、「優先設定無し」と「優先設定有り」とのうちの「優先設定有り」を選択することにより、複数の合焦ポイントで合焦状態を実現することが困難な場合でも、いずれかの合焦ポイントを優先させて合焦制御を行うための設定を行うことができるように構成されている。

【0109】「優先設定有り」が選択されると、図17に示す設定画面に画面表示が切り替わり、ユーザは、図17の画面表示に基づいて、どのような合焦ポイントを優先させて合焦制御を行うかの設定を行う。

【0110】例えば、第1ポイント優先は、第1のAFカーソルCR1に対応するAF評価ブロックBK1が合焦状態となるように合焦制御を行う優先モードであり、第2ポイント優先は、第2のAFカーソルCR2に対応するAF評価ブロックBK2が合焦状態となるように合焦制御を行う優先モードである。また、近側被写体優先は、第1及び第2のAFカーソルCR1、CR2を含む合焦領域のうちで、最もデジタルカメラ1に近い位置にある被写体が含まれているAF評価ブロックが合焦状態となるように合焦制御を行う優先モードであり、遠側被写体優先は、第1及び第2のAFカーソルCR1、CR2を含む合焦領域のうちで、最もデジタルカメラ1から遠い位置にある被写体が含まれているAF評価ブロックが合焦状態となるように合焦制御を行う優先モードである。

【0111】そしてユーザはプリファレンスモード時に、上記のような優先モードのうちから一のモードを選択しておくことにより、撮影モード時に複数の合焦ポイントで合焦状態を実現することが困難な場合、選択された優先モードに応じた合焦ポイントが優先されて合焦制御が行われる。

【0112】以下、デジタルカメラ1のLCD10に複数のAFカーソルCR1、CR2が表示されている場合

における合焦動作についてフローチャートを参照しつつ、説明する。

【0113】<2-1. 合焦ポイントによる合焦制御> まず、合焦ポイントで合焦制御を行う場合であって、優先設定が行われていない場合での状態ST8（図15参照）における合焦動作について説明する。

【0114】図18及び図19は合焦ポイントによる合焦制御の動作を示すフローチャートである。まず、撮影モード時において、全体制御部211はシャッターボタン8が半押し（S1）状態とされたか否かを判断する（ステップS100）。そしてシャッターボタン8の半押し状態を検知すると、ステップS102に進む。

【0115】シャッターボタン8が半押し状態にされると、全体制御部211は、第1のAFカーソルCR1に対応するカーソル位置の被写体を測距し、被写体距離Laを算出する（ステップS102）。また、全体制御部211は、第2のAFカーソルCR2に対応するカーソル位置の被写体を測距し、被写体距離Lbを算出する（ステップS104）。具体的には、全体制御部211がAFモータ駆動回路216に駆動信号を与えることにより、撮影レンズ301を微小ピッチで段階的に移動させ、各レンズ位置において得られる画像信号から、各カーソル位置に対応するAF評価ブロックについて図11に示すような評価値を求め、その評価値の最大値を示すレンズ位置から被写体距離La、Lbを求める（図12参照）。

【0116】そして、全体制御部211はステップS102及びS104で得られる被写体距離La、Lbの大小関係を求める（ステップS106）。これにより、第1のAFカーソルCR1に対応する被写体と、第2のAFカーソルCR2に対応する被写体とのいずれの被写体がデジタルカメラ1に近い位置にあるかを判定することができる。

【0117】全体制御部211は、距離La、Lbの中間点を求めることにより、被写体距離wを求める（ステップS108）。例えば、 $w = (La + Lb) / 2$ の演算を行うことにより、被写体距離wを求めることができる。ここで求められる被写体距離wが、図13及び図14に示す被写体距離wであり、被写体深度の中心位置となる。

【0118】また、被写体距離wが求めれば、被写体距離wの位置にある被写体を合焦状態に設定するためのレンズ位置を一義的に求めることができる。そのため、全体制御部211は、被写体距離wの位置が合焦状態となるように撮影レンズ301を駆動する（ステップS110）。なお、より簡単には、図11に示すように得られる各AFカーソル位置に対応する評価値C1、C2の中間点を求め、その中間点に対して撮影レンズ301を駆動するようにしてもよい。

【0119】そして全体制御部211は、デジタルカメ

ラ1における現在の設定値（特に絞り値F）に基づいて、被写界深度の両端位置L1、L2を求め（ステップS112、図13）、撮影レンズ301の絞り等の設定値が現在の設定値のままで全てのAFカーソル位置の合焦が可能か否かを判断する（ステップS114）。

【0120】具体的には、上述した数1及び数2の式に基づく演算を行うことによって、現在の設定値による被写界深度の両端までの距離L1、L2を求め、 $L1 \leq La$ 及び $L2 \geq Lb$ の関係が成立するか否かを判断する。ここで、 $L1 \leq La$ 及び $L2 \geq Lb$ の関係が成立する場合には、AFカーソルCR1、CR2に対応する位置にある被写体が被写界深度内に収まっていることになるので、現状のままで各AFカーソルCR1、CR2の被写体が合焦状態として得られていることになる。そのため、 $L1 \leq La$ 及び $L2 \geq Lb$ の関係が成立する場合には、特別な処理を行うことなく、合焦動作を終了する。

【0121】一方、 $L1 \leq La$ 及び $L2 \geq Lb$ の関係が成立しない場合には、AFカーソルCR1、CR2に対応する位置にある被写体が被写界深度内に収まっていないことになるので、各AFカーソルCR1、CR2の被写体を合焦状態に導くために、複数ポイントの合焦処理（ステップS116）が行われる。

【0122】ステップS116の処理の詳細を、図19のフローチャートに示す。複数の合焦ポイントを合焦状態に導くために、絞り値Fを現在の設定値よりも大きくして、絞りを絞り込む（ステップS122）。つまり、絞りの開放径を小さくすることにより、距離L1の値を小さく、かつ、距離L2の値を大きくして、被写界深度をより深くする（数1及び数2の式を参照）。この結果、ステップS114（図18参照）において $L1 \leq La$ 及び $L2 \geq Lb$ の関係が成立しなかった場合でも、被写界深度を深くすることで、 $L1 \leq La$ 及び $L2 \geq Lb$ の関係が成立するように設定変更を行うことができる。ただし、絞りを絞り込む際には、 $L1 \leq La$ 及び $L2 \geq Lb$ の関係が成立するように絞り値Fの値を決定することが必要である。

【0123】そしてステップS124に進み、絞り値Fを変更した後、その変更後の絞り値Fに基づいて、シャッタースピードを現在の設定値よりも遅く設定する。一般に、絞りを絞り込んだ場合は露出レベルが低下するため、絞り値Fを変更したことによる露出レベルの補償を行うことが必要である。そこで、この実施の形態では、絞りを絞り込むことで被写界深度を深くした場合に、それに伴う露出レベルの低下を抑制するために、変更後の絞り値Fに応じてシャッタースピードが遅くなるように設定される。これにより、絞り値Fを変化させる前後で同程度の露出レベルを実現することができ、適切な露出レベルでの撮影動作を行うことが可能になる。

【0124】ところで、シャッタースピードが所定の限界値よりも遅くなるような場合には、手ブレ現象が発生す

ることも予想される。そのため、ステップS126では、シャッタースピードが所定の限界値よりも遅くなるか否かを判断することにより、手ブレ現象の発生の有無を検査する。ここでシャッタースピードが所定の限界値よりも遅くなる場合にはステップS128に進む。その一方、シャッタースピードが所定の限界値よりも遅くならない場合には、複数の合焦ポイントが同時に合焦状態とされ、かつ、露出レベルも適正レベルに維持されるので、複数ポイントの合焦処理を終了する。

【0125】ステップS128では、シャッタースピードを限界値に設定し、手ブレ現象が発生することを防止する。そしてステップS130に進み、全体制御部211は信号処理回路313に含まれるAGC回路のゲインをゲインアップさせる。すなわち、シャッタースピードの低下が限界値で制限されるため、AGC回路のゲイン値を現在の設定値よりも高い値に設定することで、露出レベルを適正レベルに補償するのである。

【0126】ところがゲインアップを行う場合でも、ゲインの設定不可能な値にまでゲインアップを行うことはできない。また、ゲインアップによってノイズ成分が目立つようになることは避けなければならない。このため、ステップS132では、ゲイン値がゲインアップの上限値であるか否かを判断する。この上限値としては、ゲインアップの限界値、又は、ノイズ成分が所定レベル以上となるゲイン値等が用いられる。ここで、ゲインアップ後のゲイン値が上限値を超えない場合には、複数の合焦ポイントが同時に合焦状態とされ、かつ、露出レベルも適正レベルに維持されるので、複数ポイントの合焦処理を終了する。一方、ゲインアップの上限値を超える場合には、ステップS134に進む。

【0127】ステップS134では、絞りを絞り込むだけでは、複数の合焦ポイントを同時に合焦状態とし、かつ、露出レベルも適正レベルに維持することができないので、全体制御部211が警告を発生させる。例えば、LCD10の画面上に画質を劣化させることなく複数の合焦ポイントを同時に合焦状態とすることが出来ない旨の警告表示を行う。

【0128】そして全体制御部211は、撮影解像度を低下させる（ステップS136）。このとき、撮影レンズ301における絞りの開放径は絞り込んだ状態から若干小さくされ（すなわち、絞り値Fは若干小さくされ）、シャッタースピード及びゲイン値の調整だけでは適正露出とすることができなかった露出レベルを適正レベルに調整する。このとき、絞り値Fが小さくなるので、複数の合焦ポイントに対応する被写体が被写界深度内から外れる可能性がある。そのため、全体制御部211が撮影解像度を制御することによって撮影解像度を低下させ、複数の合焦ポイントに対応する被写体を被写界深度内に収めるようにする。

【0129】すなわち、ステップS136では、数1及

び数2の式の画素ピッチdを大きくすることによって複数の合焦ポイントに対応する被写体を被写界深度内に収めるようにし、かつ、露出レベルの適正化を図っているのである。

【0130】このような合焦ポイントによる合焦制御の動作を行うことにより、指定された複数の合焦ポイントに対応する各被写体までの距離に応じて被写界深度が調整され、各被写体が被写界深度内に収まるようにデジタルカメラ1の内部状態が制御されるので、遠近競合する画像であっても、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことが可能になる。また、撮影して得られる画像は常に適正露出となるようにも制御される。

【0131】なお、図19のフローチャートでは、シャッタースピードが所定の限界値よりも遅く場合に、ゲインアップを行うように動作手順が構築される例を示したが、シャッタースピードが所定の限界値よりも遅く場合はユーザがシャッターボタン8を全押し(S2)操作すること、すなわちレリーズ操作を行うことを禁止するように構築してもよい。

【0132】また、図19のフローチャートでは、ゲインアップの上限値を超える場合に、警告を発生して撮影解像度を制御するように動作手順が構築される例を示したが、ゲインアップの上限値を超える場合もユーザがレリーズ操作を行うことを禁止するように構築してもよい。

【0133】また、ステップS136で撮影解像度を低下させることを設定した場合、ユーザがシャッターボタン8の全押し操作(S2)を行って、本撮影動作を行うと、ユーザが希望する解像度の画像が得られないことになる。そのため、ステップS136において撮影解像度を低下させた場合には、本撮影動作によって得られる画像に対して画素補間処理を施すことによって擬似的に撮影解像度を上昇させて、メモ리카ード91に記録することが好ましい。

【0134】<2-2. 評価領域による合焦制御>次に、AFカーソルCR1、CR2に対応するAF評価ブロックBK1、BK2を含み、かつAFカーソルCR1、CR2の位置関係によって定まる評価領域で合焦制御を行う場合であって、優先設定が行われていない場合での状態ST8(図15参照)における合焦動作について説明する。

【0135】図20は評価領域による合焦制御の動作を示すフローチャートである。まず、撮影モード時において、全体制御部211はシャッターボタン8が半押し(S1)状態とされたか否かを判断する(ステップS200)。そしてシャッターボタン8の半押し状態を検知すると、ステップS202に進む。

【0136】ステップS202では、第1のAFカーソルCR1の位置と、第2のAFカーソルCR2の位置と

から、評価領域を設定する。図21は評価領域ERの設定の一例を示す図である。例えば、第1のAFカーソルCR1及び第2のAFカーソルCR2の位置を焦点とする楕円を設定し、その楕円がブロック内の領域に半分以上含まれているAF評価ブロックを全て抽出して評価領域ERを設定する。また、最も簡単には、第1のAFカーソルCR1及び第2のAFカーソルCR2の位置を頂点とし、第1のAFカーソルCR1及び第2のAFカーソルCR2を結ぶ線分を対角線とする矩形領域を設定し、その矩形領域を評価領域ERとして設定してもよい。なお、これら以外の例えばBK1、BK2を含む矩形エリアを評価領域とする方法によって評価領域ERを設定してもよい。

【0137】このようにステップS202では、AFカーソルCR1、CR2に対応するAF評価ブロックBK1、BK2を含み、かつAFカーソルCR1、CR2の位置関係によって定まる評価領域ERが設定される。そして、その評価領域ERに含まれる全てのAF評価ブロックが合焦領域(AFエリア)として設定される。

【0138】次に、全体制御部211は、評価領域ERに含まれる全てのAF評価ブロックについて、被写体を測距することにより、各AF評価ブロックに含まれる各被写体までの距離を求める(ステップS204)。

【0139】そして全体制御部211は、評価領域ERに含まれる各AF評価ブロックについて求められる被写体までの距離のうちから、最大値と最小値とを求める(ステップS206)。ここで求められる最大値が図12に示す被写体距離Lbに対応し、最小値が図12に示す被写体距離Laに対応する。つまり、ステップS206において被写体までの距離の最大値と最小値とが求められることにより、被写体距離La、Lbが求められる。

【0140】そして全体制御部211は、距離La、Lbの中間点を求めることにより、被写体距離wを求める(ステップS208)。例えば、 $w = (La + Lb) / 2$ の演算を行うことにより、被写界深度の中心位置に相当する被写体距離wを求めることができる。そして、この被写体距離wに基づいて、被写体距離wの位置にある被写体を合焦状態に設定するためのレンズ位置を求め、そのレンズ位置に撮影レンズ301を駆動する(ステップS210)。この結果、被写体距離wの位置にある被写体の合焦状態が実現される。

【0141】そして全体制御部211は、デジタルカメラ1における現在の設定値(特に絞り値F)に基づいて、被写界深度の両端位置L1、L2を求め(ステップS212、図13)、撮影レンズ301の絞り等の設定値が現在の設定値のままで、評価領域ERに含まれる全てのAF評価ブロックの合焦が可能か否かを判断する(ステップS214)。

【0142】そして、評価領域ERに含まれる全てのA

F評価ブロックの合焦が可能な場合には、現状のままで各AF評価ブロックの被写体が合焦状態として得られていることになり、特別な処理を行うことなく、合焦動作を終了する。

【0143】その一方、評価領域ERに含まれる全てのAF評価ブロックの合焦が不可能な場合には、各AF評価ブロックに対応する位置にある被写体が被写界深度内に収まっていないことになるので、各AF評価ブロックの被写体を合焦状態に導くために、複数ポイントの合焦処理（ステップS216）が行われる。

【0144】なお、ステップS216における複数ポイントの合焦処理の詳細は、図19に示したフローチャートと同様である。

【0145】このような評価領域ERによる合焦制御の動作を行うことにより、指定された複数の合焦ポイントを含み、かつ、複数の合焦ポイントの位置関係によって定まる一つの評価領域ERに含まれる全ての被写体が被写界深度内に収まるように調整されるので、遠近競合する画像であっても、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことが可能になる。また、評価領域ERはAF評価ブロックよりも広い一つの領域として設定されるので、広い範囲で合焦状態が実現された撮影画像を得ることが可能になる。

【0146】＜2-3. 優先設定に基づく合焦制御＞次に、合焦ポイントで合焦制御を行う場合であって、優先設定が行われている場合での状態ST8（図15参照）における合焦動作、すなわち優先設定に基づく合焦動作について説明する。

【0147】図22及び図23は優先設定に基づく合焦制御の動作を示すフローチャートである。まず、撮影モード時において、全体制御部211はシャッターボタン8が半押し（S1）状態とされたか否かを判断する（ステップS300）。そしてシャッターボタン8の半押し状態を検知すると、ステップS302に進む。

【0148】シャッターボタン8が半押し状態にされると、全体制御部211は、第1のAFカーソルCR1に対応するカーソル位置の被写体を測距し、被写体距離Laを算出する（ステップS302）。また、全体制御部211は、第2のAFカーソルCR2に対応するカーソル位置の被写体を測距し、被写体距離Lbを算出する（ステップS304）。

【0149】そして、全体制御部211はステップS302及びS304で得られる被写体距離La、Lbの大小関係を求め（ステップS306）、距離La、Lbの中間点を求めることにより、被写体距離wを求める（ステップS308）。なお、被写体距離La、Lbの大小関係を求めることにより、第1及び第2のAFカーソルCR1、CR2のうちで近側被写体及び遠側被写体を特定することができる。また、被写体距離wにある被写体を合焦させるためのレンズ位置は、被写体距離La、L

bの双方にある被写体を同時に合焦させるための合焦位置となる。

【0150】そして全体制御部211は、デジタルカメラ1における現在の設定値（特に絞り値F）に基づいて、被写界深度の両端位置L1、L2を求め（ステップS310）、撮影レンズ301の絞り等の設定値が現在の設定値のままで全てのAFカーソル位置の合焦が可能かを判断する（ステップS312）。

【0151】そして、各AFカーソル位置の合焦が可能な場合には、現状のままで各AF評価ブロックの被写体が合焦状態として得られていることになり、特別な処理を行うことなく、合焦動作を終了する。

【0152】その一方、各AFカーソル位置の合焦が不可能な場合には、各AF評価ブロックに対応する位置にある被写体が被写界深度内に収まっていないことになる。したがって、この実施の形態では、各AFカーソル位置の被写体を同時に合焦させることが不可能な場合に、優先設定に基づく合焦処理（ステップS314）が行われる。

【0153】ステップS314の処理の詳細を、図23のフローチャートに示す。優先設定に基づく合焦処理（ステップS314）では、まず、優先設定の内容が判断される（ステップS320）。すなわち、プリファレンスモードで設定された優先設定の内容が全体制御部211によって判断され、「第1ポイント優先」が設定されている場合にはステップS322に進み、「第2ポイント優先」が設定されている場合にはステップS324に進み、「近側被写体優先」が設定されている場合には、ステップS326に進み、「遠側被写体優先」が設定されている場合には、ステップS328に進む。

【0154】ステップS322では、第1ポイント、すなわち第1のAFカーソルCR1に対応するAF評価ブロックを、優先して合焦状態とすることをユーザに報知するために第2のAFカーソルCR2を警告表示に切り換える。

【0155】図24は、AFカーソルの警告表示の一例を示す図である。図24では、一例として第2のAFカーソルCR2が警告表示のために、第1のAFカーソルとは別の色（例えば白抜き等）で表示される例を示している。このように合焦状態を実現するために有効なカーソル表示（AFカーソルCR1の表示）と、合焦状態を実現するために無効なカーソル表示（AFカーソルCR2の表示）とを区別して表示することにより、ユーザはLCD10の画面を視認するだけで、合焦状態を実現することのできない被写体を容易に特定することができる。なお、AFカーソルの警告表示の形態は表示色を変更だけでなく、他の表示形態を採用してもよい。

【0156】また、ステップS324では、第2ポイント、すなわち第2のAFカーソルCR2に対応するAF評価ブロックを、優先して合焦状態とすることをユーザ

に報知するために第1のAFカーソルCR1を警告表示に切り換える。

【0157】また、ステップS326では、近側被写体を優先して合焦状態とするため、第1及び第2のAFカーソルCR1、CR2のうちの近側被写体に対応するAFカーソルを有効表示とし、遠側被写体に対応するAFカーソルを警告表示に切り換える。

【0158】さらに、ステップS328では、遠側被写体を優先して合焦状態とするため、第1及び第2のAFカーソルCR1、CR2のうちの遠側被写体に対応するAFカーソルを有効表示とし、近側被写体に対応するAFカーソルを警告表示に切り換える。

【0159】つまり、ステップS322、S324、S326、S328のそれぞれでは、予め設定された優先設定に基づいて合焦動作を行うために、合焦動作に反映されないAFカーソルを警告表示に切り換えることで、ユーザにその旨の通知を行うように構成されている。

【0160】そして、ステップS330に進み、優先設定に基づいて第1及び第2のAFカーソルのうちの一方のAF評価ブロックについて合焦状態を実現するレンズ位置（合焦位置）が特定される。

【0161】図22のフローチャートに戻り、全体制御部211が合焦位置に対して撮影レンズ301を駆動させることにより、被写体の合焦状態を実現する（ステップS316）。ステップS314の処理が行われた場合には、このとき、優先設定に基づいて特定されたレンズ位置に撮影レンズ301が駆動される。

【0162】このような優先設定に基づく合焦制御の動作を行うことにより、指定された複数の合焦ポイントについて適切に合焦状態を実現することが困難な場合にも、優先設定された合焦ポイントだけは合焦状態を実現することが可能であるので、撮影の失敗等を防止することが可能になる。

【0163】なお、上記の優先設定に基づく合焦処理（ステップS314）は、図18及び図19のフローチャート、並びに、図20のフローチャートにおいて複数の合焦ポイントの合焦処理（ステップS116、S216）が行われた後で、合焦状態を実現することが困難であることが判明した場合にも適用することができる。

【0164】＜3. 変形例＞以上、この発明の具体的実施形態について説明したが、この発明は上記に説明した内容のものに限定されるものではない。

【0165】例えば、上記実施形態では主としてデジタルスチルカメラにおける合焦技術について説明したが、これに限定されるものではなく、デジタルビデオカメラ等にも上述した合焦技術を適用することは可能である。

【0166】さらに、本発明は、パーソナルコンピュータの指示に従ってパーソナルコンピュータに接続された撮像部から画像データを取得する、いわゆるPCカメラやインターネットにも適応でき、このようなシステムも

本発明のデジタルカメラの範疇に含まれる。

【0167】また、上記実施形態ではシャッターボタン8が半押し状態（S1）とされたときに合焦動作を行う例について説明したが、合焦動作を行うタイミングはこれに限定されるものではない。例えば、ライブビュー表示時に常時合焦動作が行われるように構成してもよいし、シャッターボタン8が全押し（S2）されたときの本撮影動作を行う直前に合焦動作を行うように構成してもよい。

【0168】なお、上述した具体的実施形態には、以下の構成を有する発明が含まれる。

【0169】（1）請求項1に記載のデジタルカメラにおいて、絞りを含む撮影レンズと、合焦動作時における前記絞りの絞り値が、前記複数の合焦ポイントに対応する前記複数の画像部分を同時に合焦状態とすることができない値である場合に、警告を発生させる警告発生手段と、をさらに備えるデジタルカメラ。

【0170】この構成により、複数の合焦ポイントに対応する被写体を同時に被写界深度内に収めることができないことを、ユーザに対して明確に示すことができる。

【0171】（2）請求項1に記載のデジタルカメラにおいて、絞りを含む撮影レンズと、合焦動作時における前記絞りの絞り値が、前記複数の合焦ポイントに対応する前記複数の画像部分を同時に合焦状態とすることができない値である場合に、前記複数の合焦ポイントのうちの少なくとも1つの合焦ポイントを無効に設定し、かつ、無効とされた合焦ポイントの前記画面での表示状態を変更する制御手段と、をさらに備えるデジタルカメラ。

【0172】この構成により、複数の合焦ポイントに対応する被写体を同時に被写界深度内に収めることができないことを、ユーザに対して明確に示すことが可能である。

【0173】（3）請求項1に記載のデジタルカメラにおいて、絞りを含む撮影レンズをさらに備え、前記合焦手段は、合焦動作時における前記絞りの絞り値が、前記複数の合焦ポイントに対応する前記複数の画像部分を同時に合焦状態とすることができない値である場合に、前記複数の画像部分を被写界深度内に収めるように、前記絞りを絞り込むことを特徴とするデジタルカメラ。

【0174】この構成により、ユーザの意図通りの合焦状態が実現されるとともに、絞りが自動的に設定されるのでユーザの操作が簡単になる。

【0175】（4）（3）に記載のデジタルカメラにおいて、前記合焦手段は、前記絞りを絞り込んだ場合に、その絞り込んだ状態の絞り値に応じて撮影時のシャッタースピードを遅くさせることを特徴とするデジタルカメラ。

【0176】この構成により、複数の合焦ポイントに対応する被写体を同時に被写界深度内に収めることができ

るとともに、一定の露光量で撮影を行うことが可能になる。

【0177】(5)(4)に記載のデジタルカメラにおいて、前記合焦手段は、前記絞りを絞り込んだ状態の絞り値に応じて前記シャッタースピードを遅くする際、前記シャッタースピードが所定値よりも遅い値になる場合に、警告を発生させることを特徴とするデジタルカメラ。

【0178】この構成により、撮影時に手ブレ現象が発生することを、予め警告することができるので、撮影が失敗することを防止することが可能である。

【0179】(6)(3)～(5)のいずれかに記載のデジタルカメラにおいて、前記合焦手段は、前記絞りを絞り込んだ場合に、その絞り込んだ状態の絞り値に応じて撮像素子から得られる画像信号のゲインアップを行うことを特徴とするデジタルカメラ。

【0180】この構成により、複数の合焦ポイントに対応する被写体を同時に被写界深度内に収めることができるとともに、一定の露光量で撮影を行うことが可能になる。

【0181】(7)(6)に記載のデジタルカメラにおいて、前記合焦手段は、前記絞りを絞り込んだ状態の絞り値に応じて前記撮像素子から得られる画像信号のゲインアップを行う際、ゲインが所定値よりも大きくなる場合には、警告を発生させることを特徴とするデジタルカメラ。

【0182】この構成により、ゲインアップによってノイズ成分が増加して、画質が低下することを、予め警告することができるので、撮影が失敗することを防止することが可能である。

【0183】(8)請求項1に記載のデジタルカメラにおいて、段階的に撮影解像度を変化させることの可能な撮像素子をさらに備え、前記合焦手段は、合焦動作時における前記絞りの絞り値が、前記複数の合焦ポイントに対応する前記複数の画像部分を同時に合焦状態とすることができない値である場合に、前記撮影解像度を低下させることを特徴とするデジタルカメラ。

【0184】この構成により、複数の合焦ポイントに対応する被写体を同時に被写界深度内に収めることが可能になり、遠近競合する画像であっても、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことができる。

【0185】(9)請求項2に記載のデジタルカメラにおいて、前記指定手段は、前記ポイント移動手段によって指定される各合焦ポイントの位置を記憶する記憶手段をさらに備えており、前記ポイント数変更手段が操作される度に、前記合焦ポイントの数を所定数となるまで増加させるように構成されており、前記合焦ポイントを増加させる際には前記記憶手段に記憶されている各合焦ポイントの位置を前記画面上に再現して表示させることを特徴とするデジタルカメラ。

【0186】この構成により、合焦ポイントを画面内で移動させた場合であってもデジタルカメラにおいてその合焦ポイントの位置が記憶されるので、操作性が向上する。

【0187】

【発明の効果】以上説明したように、請求項1に記載の発明によれば、操作入力に基づいて、表示手段の画面において複数の合焦ポイントを指定し、その複数の合焦ポイントに対応する複数の画像部分が合焦状態となるように合焦動作を行うように構成されるため、各合焦ポイントに対応する被写体までの距離が異なる場合であっても、それらの被写体を合焦させることができるので、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことが可能である。

【0188】請求項2に記載の発明によれば、指定手段が、操作入力にตอบสนองして合焦ポイントの数を変化させるように構成されるとともに、表示手段の画面における各合焦ポイントの位置を移動させるように構成されるため、ユーザが表示手段の画面を確認しながら、合焦させたい被写体を複数指定することが可能である。

【0189】請求項3に記載の発明によれば、操作入力に基づいて、表示手段の画面において複数の合焦ポイントを指定し、その複数の合焦ポイントに基づいて、複数の合焦ポイントを含む合焦領域を設定し、その合焦領域に含まれる画像が合焦状態となるように、撮影レンズを駆動制御するため、各合焦ポイントに対応する被写体までの距離が異なる場合であっても、それらの被写体を合焦させることができるので、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことが可能である。

【0190】請求項4に記載の発明によれば、操作入力に基づいて、表示手段の画面において複数の合焦ポイントを指定し、その複数の合焦ポイントに基づいて、複数の合焦ポイントを含む合焦領域を設定し、その合焦領域に含まれる画像が合焦状態となるように、絞りを駆動制御するため、被写界深度の深さが調整されて各合焦ポイントに対応する被写体を合焦させることができ、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことが可能である。

【0191】請求項5に記載の発明によれば、操作入力に基づいて、表示手段の画面において複数の合焦ポイントを指定し、その複数の合焦ポイントに基づいて、複数の合焦ポイントを含む合焦領域を設定し、その合焦領域に含まれる画像が合焦状態となるように、撮像素子の撮影解像度を制御するため、被写界深度の深さが調整されて各合焦ポイントに対応する被写体を合焦させることができ、ユーザの意図通りとなるような合焦状態を実現して撮影を行うことが可能である。

【図面の簡単な説明】

【図1】この発明の一の実施形態に係るデジタルカメラの正面図である。

【図2】この発明の一の実施形態に係るデジタルカメラの背面図である。

【図3】この発明の一の実施形態に係るデジタルカメラの側面図である。

【図4】この発明の一の実施形態に係るデジタルカメラの底面図である。

【図5】デジタルカメラの内部構成を示すブロック図である。

【図6】 画像処理部の構成を示すブロック図である。

【図7】ライブビュー表示における画像データの変換を示す図である。

【図8】合焦状態を評価するAF評価ブロックを示す図である。

【図9】 デジタルカメラ内部の部分ブロック図である。

【図10】LCDにおけるAFカーソルの表示状態を示す図である。

【図11】AF評価ブロックから算出される評価値を示す図である。

【図12】評価値に基づいて求められる被写体距離を示す図である。

【図13】被写界深度の変化の一例を説明する図である。

【図 1 4】被写界深度の変化の一例を説明する図である。

【図15】デジタルカメラの基本的な動作を示す状態遷移図である。

【図16】合焦動作モードを設定する際の表示画面を示す図である。

【図17】合焦動作モードを設定する際の表示画面を示

す図である。

【図18】合焦ポイントによる合焦制御の動作を示すフローチャートである。

【図19】合焦ポイントによる合焦制御の動作を示すフローチャートである。

【図20】評価領域による合焦制御の動作を示すフローチャートである。

【図21】評価領域の設定の一例を示す図である。

【図22】優先設定に基づく合焦制御の動作を示すフローチャートである。

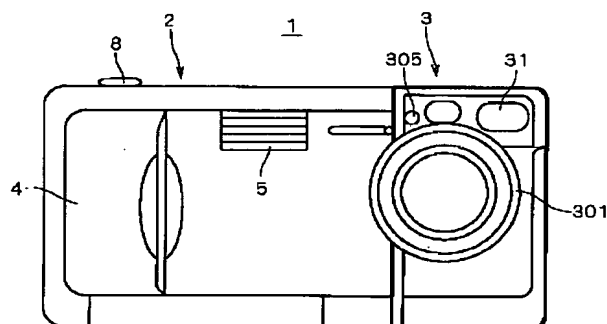
【図23】優先設定に基づく合焦制御の動作を示すフローチャートである。

【図24】AFカーソルの警告表示の一例を示す図である。

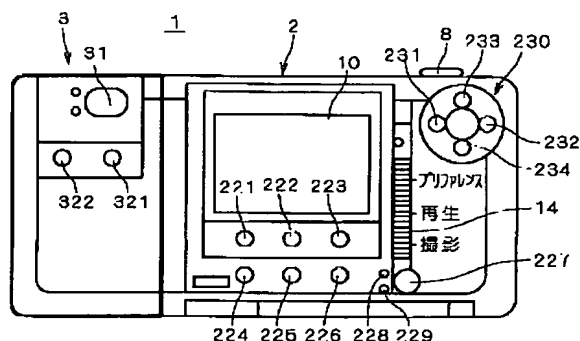
【符号の説明】

- 1 デジタルカメラ
- 8 シャッターボタン
- 10 LCD (表示手段)
- 211 全体制御部 (合焦領域設定手段, 制御手段)
- 211a DRAM (記憶手段)
- 230 4連スイッチ (ポイント移動手段)
- 225 キースイッチ、AFカーソルボタン (ポイント数変更手段)
- 301 撮影レンズ
- 303 CCD (撮像素子)
- CR1, CR2 AFカーソル (合焦ポイント)
- BK1, BK2 AF評価ブロック
- ER 評価領域

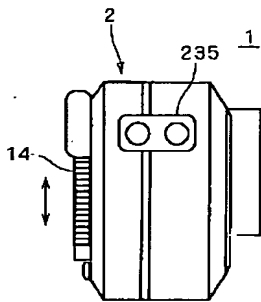
【図1】



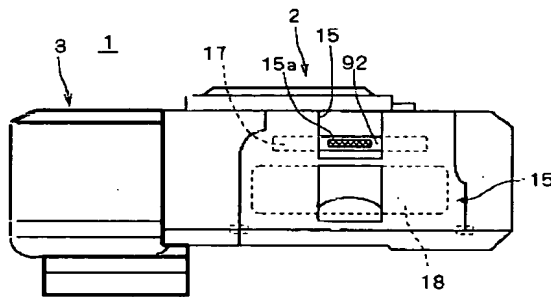
【図2】



【図3】



【図4】



【図16】

合焦動作モード設定

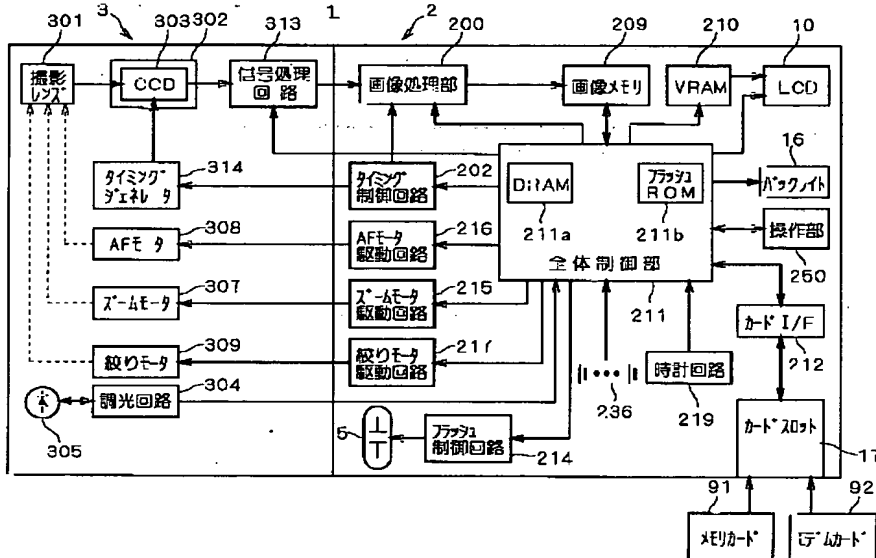
- ▶ 合焦ポイントでの合焦制御
 - ▷ 優先設定無し
 - ▷ 優先設定有り
- ▷ 評価領域での合焦制御

【図17】

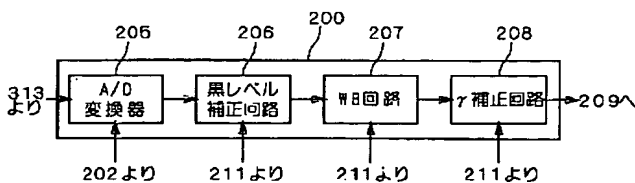
合焦ポイントの優先設定

- ▶ 第1ポイント優先
- ▷ 第2ポイント優先
- ▷ 近側被写体優先
- ▷ 遠側被写体優先

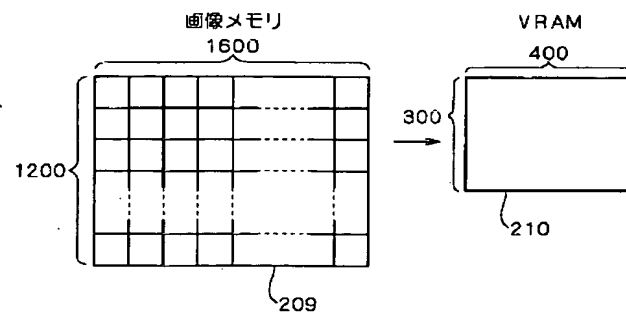
【図5】



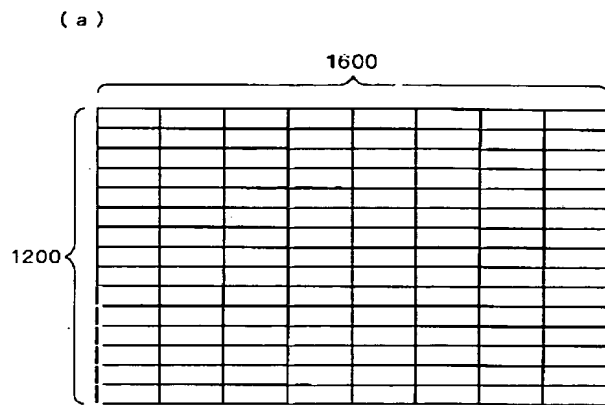
【図6】



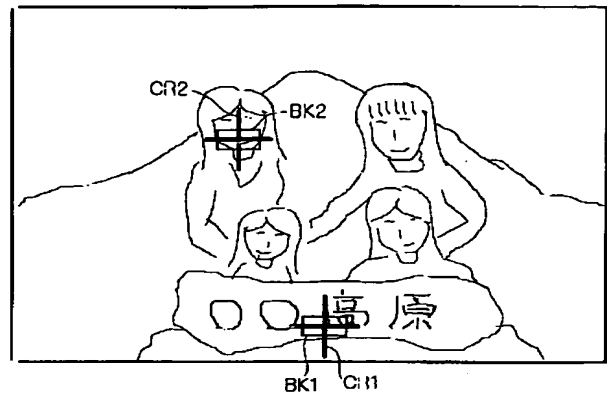
【図7】



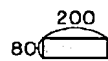
【図8】



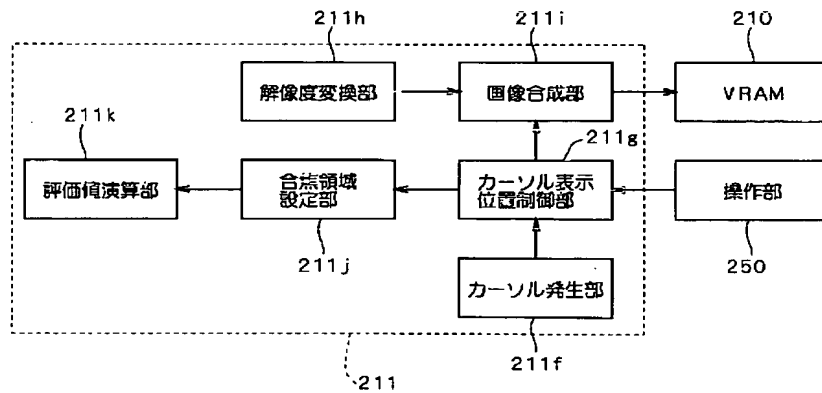
【図10】



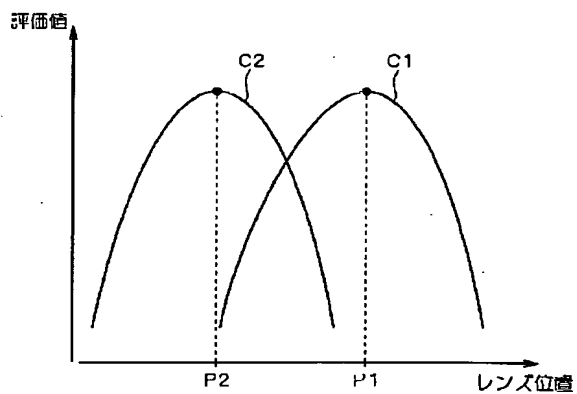
(b)



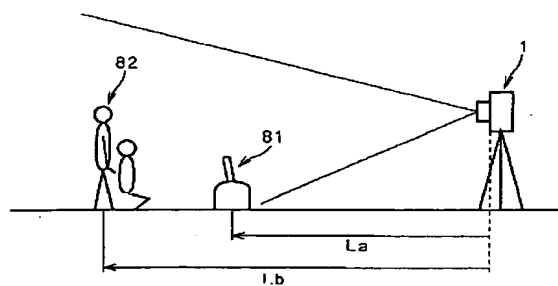
【図9】



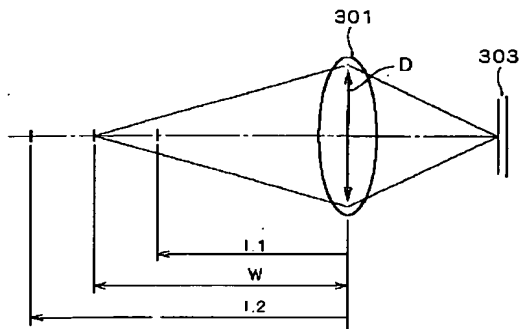
【図11】



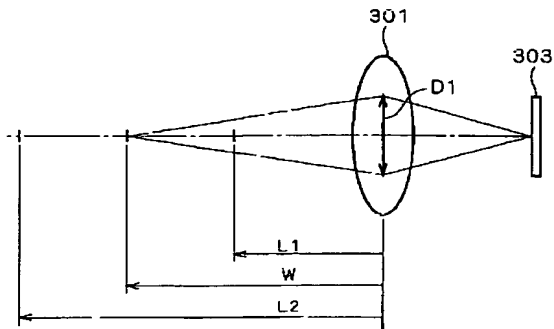
【図12】



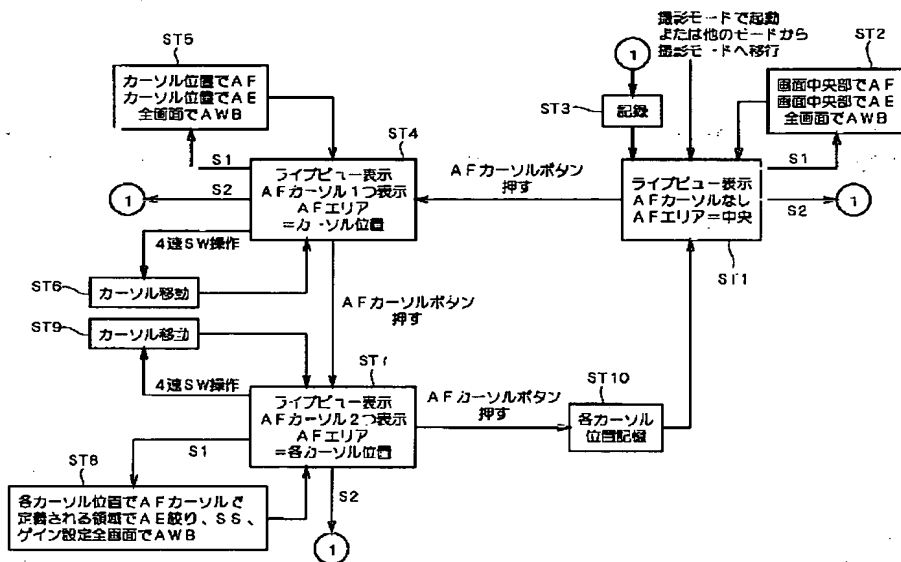
【図13】



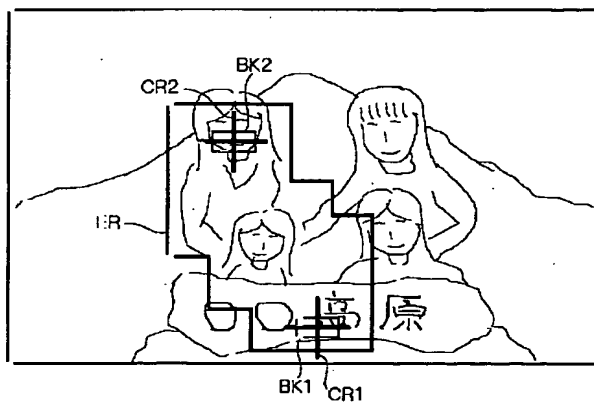
【図14】



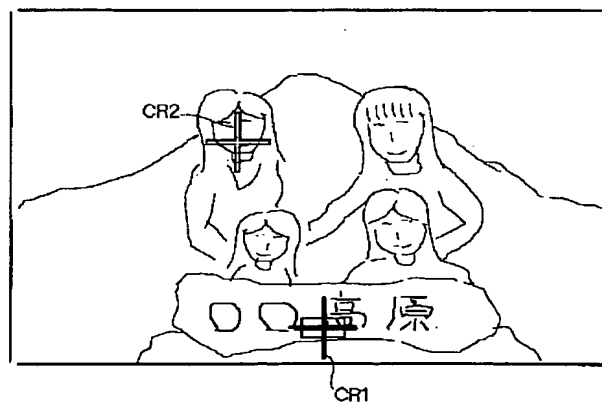
【図15】



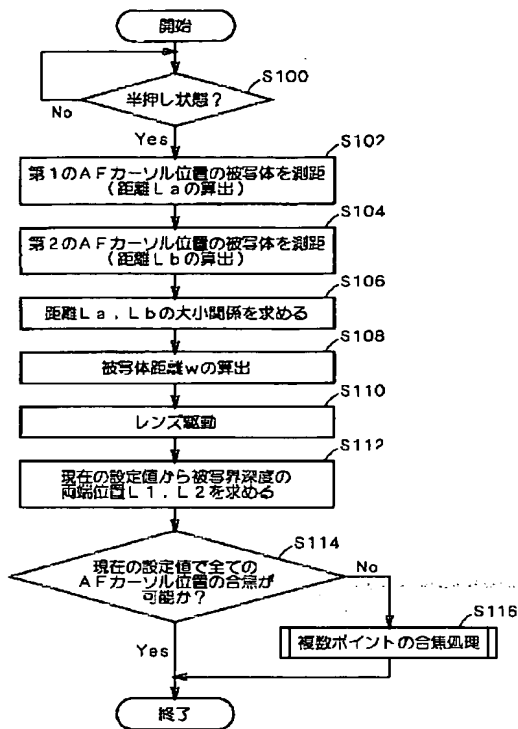
【図21】



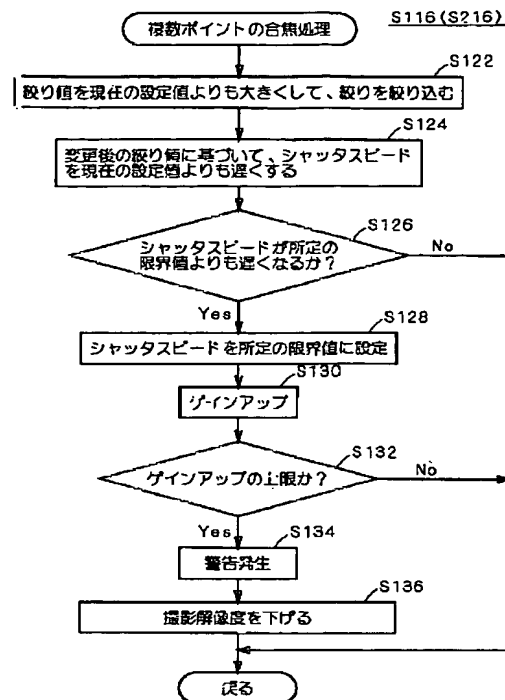
【図24】



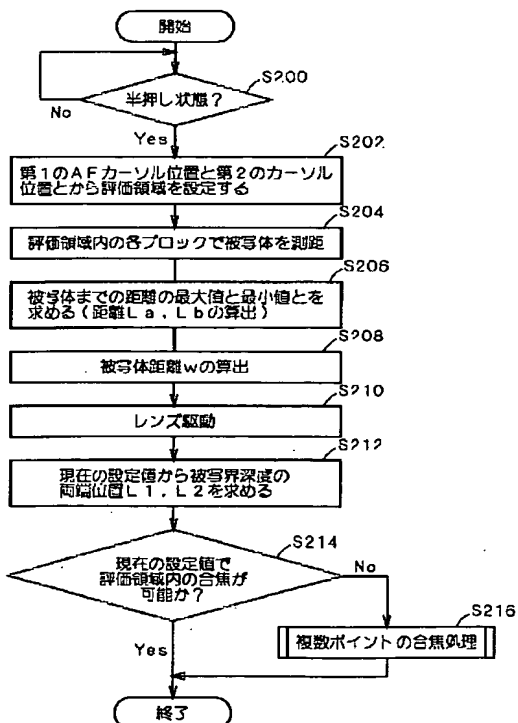
【図18】



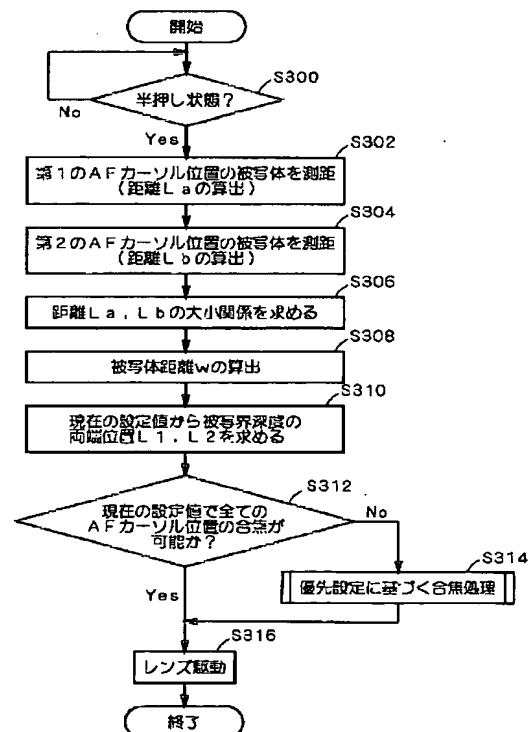
【図19】



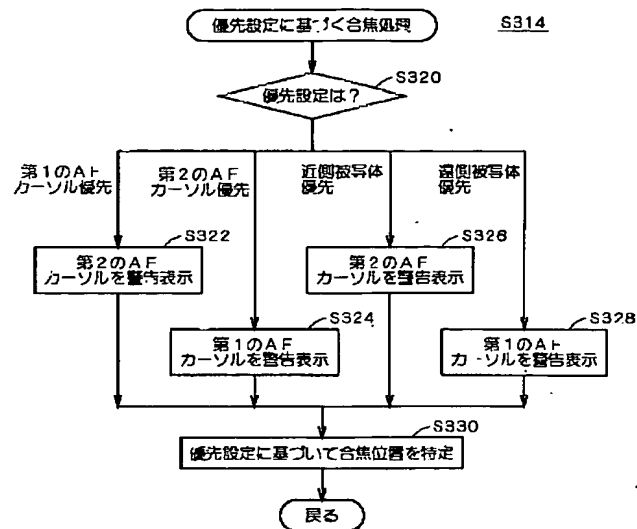
【図20】



【図22】



【図23】



フロントページの続き

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Fターム(参考) 2H002 DB02 FB29 FB31 FB33 FB58
GA20 GA54 HA01 JA07
2H011 AA03 CA21 DA05
2H051 AA00 BA41 DA07 DA19 DD10
EB06 GA09 GA17 GB20
5C022 AA13 AB22 AB30 AC01



APPLICATION NUMBER	FILING OR 371(c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/165,992	06/24/2005	Hannu Kakkori	877.0006.U1(US)

CONFIRMATION NO. 3430

29683
HARRINGTON & SMITH, LLP
4 RESEARCH DRIVE
SHELTON, CT06484-6212

Title: Adaptive optical plane formation with rolling shutter

Publication No. US-2006-0291844-A1

Publication Date: 12/28/2006

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publicly available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <http://pair.uspto.gov/>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 703-305-3028.

Pre-Grant Publication Division, 703-605-4283



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/165,992	06/24/2005	Hannu Kakkori	877.0006.U1(US)	3430
29683 7590 02/14/2008 HARRINGTON & SMITH, PC 4 RESEARCH DRIVE SHELTON, CT 06484-6212			EXAMINER KOVAL, MELISSA J	
			ART UNIT 2862	PAPER NUMBER
			MAIL DATE 02/14/2008	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

11/165,992

Applicant(s)

KAKKORI, HANNU

Examiner

Melissa J. Koval

Art Unit

2862

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 1 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-45 is/are pending in the application.
- 4a) Of the above claim(s) 1-45 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☐ Claim(s) ____ is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|--|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date ____ | 6) <input type="checkbox"/> Other: ____ |

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 17-24, 38, 39, and 41-45, drawn to a camera or a device comprising a lens, an image sensor, and exposure means, or an apparatus, classified in class 396, subclass 89.
- II. Claims 1-16, 25-37, and 40 drawn to a method or a program, classified in class 348, subclass 333.02. Various sub-classes in class 348 should be searched including: 348/36, 219.1, 239, 302, and 373. Class 382, image analysis, should also be considered.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as subcombinations disclosed as usable together in a single combination. The subcombinations are distinct if they do not overlap in scope and are not obvious variants, and if it is shown that at least one subcombination is separately usable. In the instant case, subcombination II has separate utility such as displaying additional information related to the camera operation or data related to the captured camera image in a method or program. See MPEP § 806.05(d).

The examiner has required restriction between subcombinations usable together. Where applicant elects a subcombination and claims thereto are subsequently found allowable, any claim(s) depending from or otherwise requiring all the limitations of the

allowable subcombination will be examined for patentability in accordance with 37 CFR 1.104. See MPEP § 821.04(a). Applicant is advised that if any claim presented in a continuation or divisional application is anticipated by, or includes all the limitations of, a claim that is allowable in the present application, such claim may be subject to provisional statutory and/or nonstatutory double patenting rejections over the claims of the instant application.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Melissa J. Koval whose telephone number is (571) 272-2121. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Assouad can be reached on (571) 272-2210. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Application/Control Number:
11/165,992
Art Unit: 2862

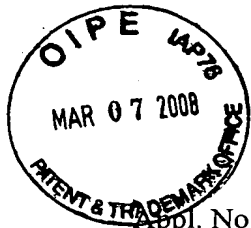
Page 4

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Melissa Jan Koval
Primary Examiner
Art Unit 2862
MJK



MELISSA JAN KOVAL
PRIMARY EXAMINER



TH

IN THE U.S. PATENT AND TRADEMARK OFFICE

Appl. No. : 11/165,992
Applicant : Kakkori, Hannu
Filed : June 24, 2005
TC/AU : 2862
Examiner : Koval, Melissa J.

Docket No. : 877.0006.U1(US)
Customer No. : 29683

Title : ADAPTIVE OPTICAL PLANE FORMATION WITH ROLLING SHUTTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Sir:

In response to the Office Action (Restriction Requirement) dated February 14, 2008, please amend the above-identified application as follows.

Amendments to the Specification: None.

Amendments to the Claims: begin at page 2 of this paper.

Amendments to the Drawings: None.

Remarks/Arguments begin on page 7 of this paper.

Appendix: None.

Applicant believes that the filing of this paper is within the allotted shortened statutory period for reply and no petition for time extension or fee is seen due. However, should the undersigned representative be mistaken, please consider this a petition for an extension of time that may be required to maintain the pendency of this patent application and/or charge Deposit Account No. 50-1924 for any required fee deficiency.

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

- 1.(Original) A method for imaging a scene comprising:
manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and
exposing different portions of the image sensing surface synchronous with manipulating the optical relationship.
- 2.(Original) The method of claim 1, wherein at least one of manipulating the optical relationship and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.
- 3.(Original) The method of claim 1, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.
- 4.(Original) The method of claim 3, wherein manipulating the optical relationship comprises manipulating between a first effective image distance and a second effective image distance, wherein the first and second effective image distances correspond respectively to the first and second object distances.
- 5.(Original) The method of claim 1, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.
- 6.(Original) The method of claim 1, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.
- 7.(Original) The method of claim 1, wherein the image sensing surface comprises an array of pixels in adjacent rows, wherein a first portion of the array is exposed while the image

sensing surface is at a first effective image distance, and a second portion of the array is exposed while the sensing surface is at a second effective image distance, and wherein at least one pixel of the first portion is in the same row of the array as at least one pixel of the second portion.

8.(Original) The method of claim 1, wherein manipulating the optical relationship synchronously with exposing operates to impose an effective curvature to the sensing surface, at least a cross section of said effective curvature approximating at least a cross section of a Petzval surface.

9.(Original) The method of claim 1, wherein the image sensing surface comprises photographic film.

10.(Original) The method of claim 1, wherein the image sensing surface comprises an array of photosensitive pixels.

11.(Original) The method of claim 1, wherein manipulating the optical relationship comprises moving at least one of the lens and the sensing surface relative to one another.

12.(Original) The method of claim 1, wherein manipulating the optical relationship comprises altering a shape of the lens.

13.(Currently Amended) A method for imaging a scene comprising:
determining a first object distance between a first object in a scene and a lens;
determining a second object distance between a second object in the scene and the lens;
within a continuous exposure frame:
exposing a first portion of an image sensing surface while the image sensing surface is at a first effective image distance from the lens, where the first effective image distance corresponds to the first object distance;
exposing a second portion of the image sensing surface while the image sensing surface is at a second effective image distance from the lens, where the second effective image distance corresponds to the second object distance; and

~~combine~~combining the exposed first and second portions into a single image.

14.(Original) The method of claim 13, wherein the single image is displayed on a digital graphical user interface.

15.(Original) The method of claim 13, wherein exposing the first and second portion of the image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected brightness of the first and second objects.

16.(Original) The method of claim 13, wherein exposing the first and second portion of the image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected speed of movement of the first and second objects.

17-24.(Canceled)

25.(Original) A program of machine-readable instructions, tangibly embodied on an information bearing medium and executable by a digital data processor, to perform actions directed toward operating a camera, the actions comprising:

during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface.

26.(Original) The program of machine-readable instructions according to claim 25, wherein at least one of maintaining the image sensing surface at a variable effective image distance and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.

27.(Original) The program of machine-readable instructions according to claim 25, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.

28.(Original) The program of machine-readable instructions according to claim 27, wherein maintaining an image sensing surface at a variable effective image distance comprises

varying between a first and a second image distance that respectively correspond to the first and second object distances.

29.(Original) The program of machine-readable instructions according to claim 25, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.

30.(Original) The program of machine-readable instructions according to claim 25, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.

31.(Original) The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises an array of pixels for which the program controls exposure of pixels according to rows.

32.(Original) The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises an array of pixels for which the program controls exposure of pixels individually.

33.(Original) The program of machine-readable instructions according to claim 25, wherein maintaining an image sensing surface at a variable effective image distance synchronously with exposing operates to impose an effective curvature to the sensing surface, at least a cross section of said effective curvature approximating at least a cross section of a Petzval surface.

34.(Original) The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises photographic film.

35.(Original) The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises an array of photosensitive pixels.

36.(Original) The program of claim 25, wherein maintaining the image sensing surface at a variable effective image distance from the lens comprises moving the lens relative to the sensing surface.

37.(Original) The program of claim 25, wherein maintaining the image sensing surface at a variable effective image distance from the lens comprises changing a shape of the lens.

38-39.(Canceled)

40.(Original) A method of imaging a scene comprising:

imposing on a sensing surface an effective optical curvature that depends from a scene, and

collecting an electronic image of the scene at the sensing surface with the effective optical curvature.

41-45.(Canceled)



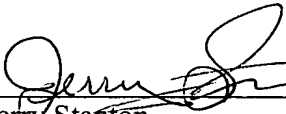
Remarks/Arguments:

This application was filed with claims 1-45. The office action dated February 14, 2008 asserted two inventions as group I (claims 17-24, 38-39 and 41-45) and group II (claims 1-16, 25-37 and 40). The Applicant hereby elects the claims of group II, and the claims of group I are canceled herein.

Claim 13 is amended to correct a grammatical error, not related to patentability.

Applicant respectfully requests examination of the elected claims on the merits.

Respectfully submitted:



Jerry Stanton
Reg. No.: 46,008

March 3, 2008
Date

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

3/3/2008
Date



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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 11/165,992		Filing Date 06/24/2005		<input type="checkbox"/> To be Mailed	
APPLICATION AS FILED – PART I										
(Column 1)			(Column 2)		SMALL ENTITY <input type="checkbox"/>		OR		OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE (\$)	FEE (\$)	RATE (\$)	FEE (\$)				
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A		N/A					
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A		N/A					
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A		N/A					
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X \$	=	OR	X \$	=			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X \$	=		X \$	=			
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))	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).									
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))										
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL				
APPLICATION AS AMENDED – PART II										
(Column 1)			(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY	
AMENDMENT	03/07/2008	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	RATE (\$)	ADDITIONAL FEE (\$)		
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	Independent (37 CFR 1.16(h))	* 4	Minus	*** 7	=	0	OR	X \$210=	0	
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<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))										
						TOTAL ADD'L FEE	OR	TOTAL ADD'L FEE	0	
(Column 1)			(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY	
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	RATE (\$)	ADDITIONAL FEE (\$)		
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	Independent (37 CFR 1.16(h))	*	Minus	***	=		OR	X \$	=	
<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))										
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))										
						TOTAL ADD'L FEE	OR	TOTAL ADD'L FEE		
<p>* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.</p> <p>** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".</p> <p>*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".</p> <p>The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.</p>										

Legal Instrument Examiner:
/PATRICIA WARNER/

This collection of information is required by 37 CFR 1.16. 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 12 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PLUS Search Results for S/N 11165992, Searched Tue Jun 03 16:49:45 EDT 2008
 The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

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5841590 98	4277156 98	4494819 98
5844670 98	4280142 98	4496229 98
5870635 98	4282548 98	4497617 98
5892626 98	4284337 98	4498763 98
5892998 98	4285590 98	4498735 98
5900963 98	4288149 98	4504135 98
5910860 98	4298274 98	4506958 98
5923368 98	4299457 98	4509831 98
5933286 98	4302084 98	4518239 98
5936783 98	4320947 98	4518221 98
5946110 98	4329022 98	
RE36299 98	4329577 98	
5959769 98	4330202 98	
5963694 98	4341447 98	
5969878 98	4349254 98	
5969875 98	4353640 98	
5978149 98	4357083 98	
5978158 98	4360264 98	
5982561 98	4364629 98	
5995132 98	4365871 98	
6025961 98	4367010 98	
6031639 98	4370591 98	
6043941 98	4371245 98	
6044232 98	4371235 98	
6057964 98	4380374 98	



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/165,992	06/24/2005	Hannu Kakkori	877.0006.U1(US)	3430
29683	7590	07/01/2008		
HARRINGTON & SMITH, PC 4 RESEARCH DRIVE SHELTON, CT 06484-6212			EXAMINER KOVAL, MELISSA J	
			ART UNIT	PAPER NUMBER
			2862	
			MAIL DATE	DELIVERY MODE
			07/01/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 11/165,992	Applicant(s) KAKKORI, HANNU	
	Examiner MELISSA J. KOVAL	Art Unit 2862	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 March 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16,25-37 and 40 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16,25-37 and 40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 June 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Claims 17-24, 38-39 and 41-45 of group I are cancelled by applicant.

Election was made **without** traverse in the reply filed on March 7, 2008.

Claim Rejections - 35 USC § 102

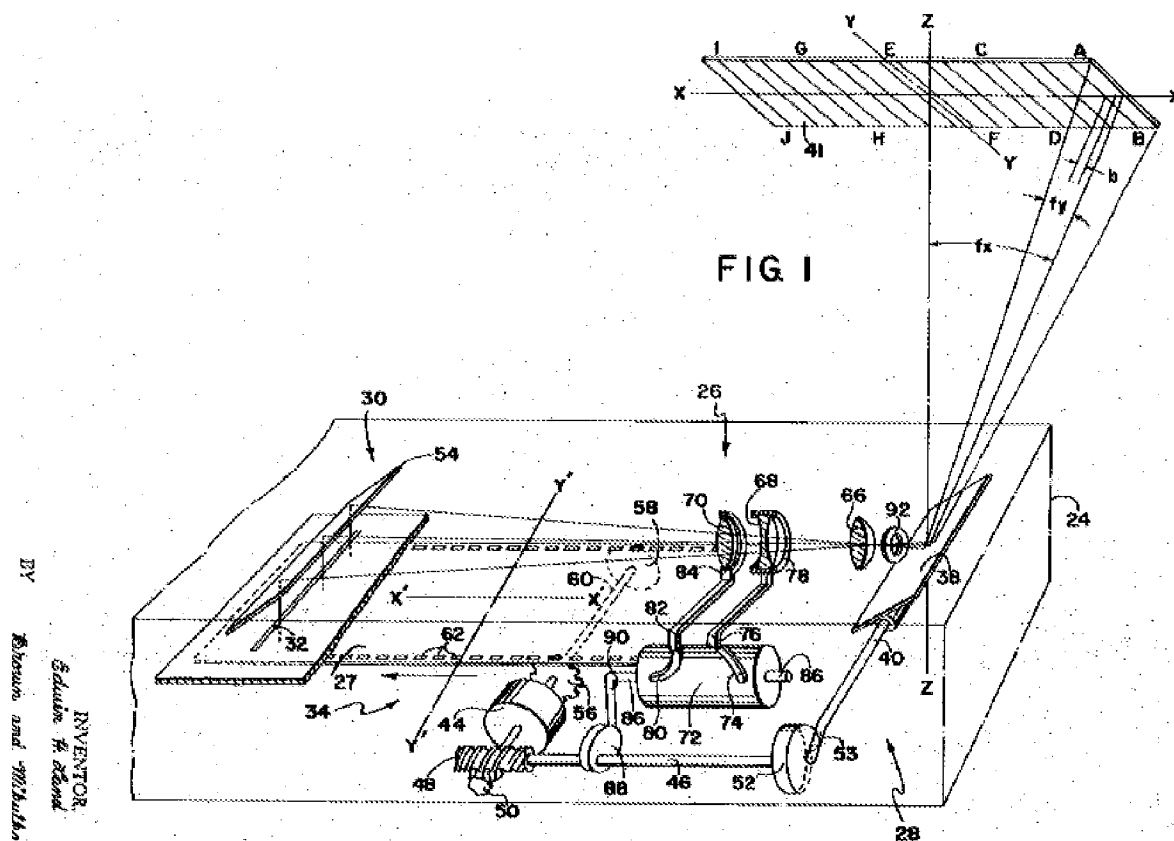
2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

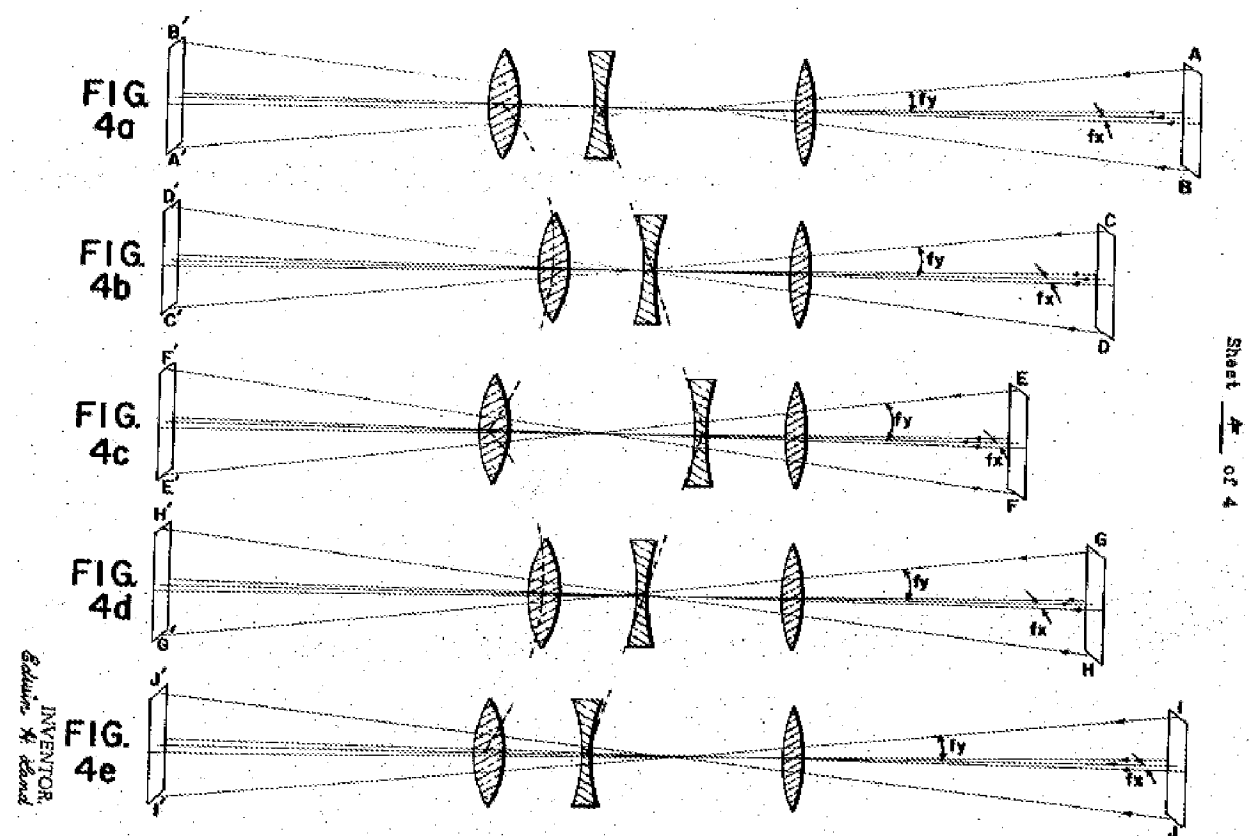
A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-4 and 9-11 are rejected under 35 U.S.C. 102(b) as being anticipated by Land U.S. Patent 3,537,373.

The examiner refers to both Figures 1 and 4a-4e.





4. Claim 1 sets forth: "A method for imaging a scene comprising (See the scanning exposure system of Figure 1 comprising image-forming means 26):
- manipulating an optical relationship between an optical lens (movable second and third lens elements 68 and 70) and an image sensing surface (photosensitive materials 27) so that the image sensing surface is spaced at different effective image distances from the lens (See transport means 34 and associated elements described, for example, in column 6, lines 59 through 72, and column 7, lines 53 through 74.

Transport means 34 are provided for transporting the
60 photosensitive materials 27 behind the exposure slit 32 during
an exposure interval at a velocity which is closely coordinated
with the sweep rate of the scanning mirror 38. Careful correlation
between the film transport velocity and the scan rate is
65 necessary in order that successively scanned object points are
imaged in the correct adjacent relationship on the photosensi-
tive materials 27 to cause the image formed on the photosensi-
tive materials 27 to be substantially stationary with respect
thereto. Such transport means may include the motor 44 and a
pair of sprockets 56, 58, mounted on shaft 60 for engaging
70 perforations 62 in the photosensitive material 27 to provide a
driving connection between the motor 44 and the photosensi-
tive material 27.

In FIG. 1 the zoom lens is illustrated as comprising a for-
ward positive element 66, and axially variable negative second
element 68 and an axially variable positive third element 70.
The forward element 66 is illustrated as being fixed in order to
illustrate that no movement thereof is necessary during expo-
sure to accomplish the objects of the invention. However, in
practice, this element 66 would be capable of axial adjustment
for effecting focus adjustments to accommodate objects at dif-
ferent object distances.

An axial cam 72 is provided for effecting axial movement
during an exposure interval of the second and third lens ele-
ments 68 and 70, respectively. Cam 72 includes a first
camming slot 74 for driving a cam follower 76 connected to
lens support 78 for the negative second element 68. A second
camming slot 80 drives a cam follower 82 connected to a lens
support for the positive third lens element 70.

In order that the cam 72 may be driven during an exposure
interval in coordination with the sweep of scanning mirror 38,
cam 72 is mounted for rotation about a shaft 86 which is
driven with an oscillating motion by a radial cam 88 on shaft
46 which engages a transverse arm 90 extending from shaft
86. By a proper design of the configuration of radial cam 88,
cam 72, and the camming slots 74, and 80, the relative spacing

); and

exposing different portions of the image sensing surface synchronous with manipulating

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the optical relationship (See column 7, lines 1 through 52.

shutter. The time during which each point on the photosensitive material 27 is exposed during a total exposure interval accords with the relationship:

$$T = S/V \quad 5$$

Where S = slit width and V = velocity at which the photosensitive material 27 is transported relative to the exposure slit 32.

It is evident that by a proper selection and correlation of the rotational speed of the motor 44, the gear ratio of the worm gears 48, 50, the relative radii of the sprockets 56, 58 and the shaft 60 upon which they are mounted, and the factors involved in the cam drive by axial cam 52 of the mirror 38, the rate at which the object 41 is scanned by the scanning mirror 38 may be very closely coordinated with the velocity at which the photosensitive material 27 is transported behind the exposure slit 32.

It is noted that a constant sweep rate of the scanning mirror, assuming a constant velocity of the photosensitive materials during exposure, would produce an image that is smeared increasingly toward the extremes of the field. This smearing of the image is a result of the increasing effective sweep rate across the surface of the photosensitive material 27 at increasing off-axis scan angles. A comprehensive understanding of the sweep velocity characteristic of the scanning mirror 38 which is necessary to produce an image without smear is not essential to the understanding of this invention and, accordingly, an in depth analysis of this problem is not thought to be appropriate here. However, it is noted that required sweep rate is a function of the square of the cosine of the instantaneous scan angle.

In accordance with the principles of this invention, means are provided for altering the scale of elemental images formed successively during an exposure interval such that all parts of the total image formed are substantially free of cylindrical perspective distortion.

In order that the magnification of successively formed elemental images may be varied as the object is scanned, in accordance with this invention the image-forming means 26 is varifocal. A simple, mechanically compensated three-element varifocal zoom lens is depicted in order that the principles of the invention may be most clearly explained. It is to be understood, however, that optically compensated, rather than mechanically compensated, zoom systems may also be employed. In practice a much more complex, highly corrected zoom lens would be preferred to the illustrated three-element lens. It is further noted that a zoom lens employed in accordance with this invention may also be afocal and used in conjunction with a fixed-focus rear element.

5. Claim 2 sets forth: "The method of claim 1, wherein at least one of manipulating the optical relationship and exposing different portions of the image sensing surface are

adaptive to objects in a scene to be imaged at the sensing surface." See object 28 that is scanned by scanning mirror 28.

6. Claim 3 sets forth: "The method of claim 1, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance." See Figures 4a through 4e. See column 9, lines 1 through 33.

It will be seen from a study of FIGS. 4a-4e that because of the perspective relationship between object and image, the half-field angles f_x along the Y-Y axis and f_y along the X-X axis subtended by object strip AB at one extreme of the field are smaller than for strip CD closer to the Z-Z axis or strip EF on the axis. Correspondingly, on the opposed side of the Z-Z axis, the half-field angles f_x and f_y decrease to a minimum at the extreme strip IJ. Hence, to compensate for this condition, the separation of elements 66 and 68 is varied during an exposure interval such that all parts of the total image formed have the same scale. The broken line path linking FIGS. 4a-4e represent the locus of travel through which negative element 68 may be moved to effect an alteration of the magnification which will accomplish this scale uniformity throughout the image.

As is well known from the principles of zoom lens systems, the movement of the negative second element 68 toward the positive first element 66 to alter the effective focal length will have the effect of causing the focal plane to shift in a manner which may be described by a second order curve. To compensate for such a shift in the focal plane, the positive third element 70 is moved first toward then away from the object, as shown by the broken line path in FIG. 4a-4e, to maintain the focal plane substantially fixed at a position coincident with the plane through which the photosensitive material 27 is being transported. It is seen from FIGS. 4a-4e that the strip images R'Q', N'M', J'I', F'E', D'C', and B'A' have the same scale and lie in the same image plane. Thus, by this invention, a scanning exposure system having a folded optical path as described, is rendered capable of forming images all parts of which are substantially free from cylindrical perspective distortion and which are in sharp focus throughout.

7. Claim 4 sets forth: "The method of claim 3, wherein manipulating the optical relationship comprises manipulating between a first effective image distance and a second effective image distance, wherein the first and second effective image distances

correspond respectively to the first and second object distances.” Claim 4 is met for the same reasons already applied in the rejection of claim 3 as set forth above.

8. Claim 8 sets forth: “The method of claim 1, wherein manipulating the optical relationship synchronously with exposing operates to impose an effective curvature to the sensing surface, at least a cross section of said effective curvature approximating at least a cross section of a Petzval surface.” Petzval curvature correction is described with respect to the prior art, Figure 2. Given the teaching of the BACKGROUND OF THE INVENTION, the examiner interprets the system of Figure 1 to be free of any aberrations caused by Petzval curvature.

9. Claim 9 sets forth; “The method of claim 1, wherein the image sensing surface comprises photographic film.” Figure 1 shows a strip of film.

10. Claim 11 sets forth: “The method of claim 1, wherein manipulating the optical relationship comprises moving at least one of the lens and the sensing surface relative to one another.” See Figure 1 in view of the teachings applied in the rejection of claims 1-4, 9 and 10 as set forth above. Both the lens and the sensing surface move relative to one another.

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

12. Claims 25 -28, 33, 34, 36 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Land U.S. Patent 3,537,373 in view of Strout et al. U.S. Patent 4,484,233.

13. Claim 25 sets forth: "A program of machine-readable instructions, tangibly embodied on an information bearing medium and executable by a digital data processor, to perform actions directed toward operating a camera, the actions comprising:

during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface."

See the rejection of claim 1 under 35 U.S.C 102(b) as set forth above. Land '373 meets all of the limitations of claim 25 except for the presence of a digital processor for a user to programmably instruct.

See claims 1 through 5 of Strout '233. Strout comprises a device comprising analogous elements to those comprised by the system of Land '373. Claim 5 is provided for applicant's convenience.

5. The apparatus of claim 4 wherein said third means includes a digital processor, digital memory, and an input/output circuit, said processor being coupled to said memory and input/output circuit through an address, memory and data bus, said third means further including a user input circuit coupled to said processor through said input/output circuit whereby a user may programmably instruct said processor to generate instructions for and coupled to said printing means, first means for moving photosensitive medium, cathode ray tube and second means to expose said photosensitive photosensitive medium and said printing means according to a selected one of a plurality of formats selected through said user input circuit in response to user activation.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Land '373 in view of Strout '233 to include digital processing means. The motivation for one having ordinary skill in the art to make the modification would be to update systems in view of the evolution of the camera and printing arts from analog to digital systems. Furthermore, one having ordinary skill in the art at the time the invention was made would make the modification with a reasonable expectation of success.

14. Section 103 forbids issuance of a patent when 'the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains' ". *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734, 82 USPQ2d 1385, 1391 (2007). The question of obviousness is resolved on the basis of underlying factual determination including (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, and (3) the level of skill in the art. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966). See also *KSR*, 127 S. Ct. at 1734, 82 USPQ2d at 1391 ("While the sequence of these questions might be reordered in any particular case, the [*Graham*] factors continue to define the inquiry that controls."). The Court in *Graham* further noted that evidence of secondary considerations, such as commercial success, long felt but unsolved needs, failure of others, etc., "might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented." 383 U.S. at 18, 148 USPQ at 467. "if a court, or patent examiner, conducts this analysis and concludes the claimed subject matter was obvious, the claim is invalid under §103." *KSR*, 127 S. Ct. at 1734, 82 USPQ2d at 1391.

The mere existence of differences between the prior art and the claim does not establish nonobviousness. *Dann v. Johnston*, 425 U.S. 219, 230, 189 USPQ 257, 261 (1976). The issue is "whether the difference between the prior art and the subject matter in question "is a difference sufficient to render the claimed subject matter unobvious to one skilled in the applicable art." " *Dann*, 425 U.S. at 228-29, 189 USPQ at 261 (citation omitted). To be nonobvious, an improvement must be "more than the predictable use of prior art elements according to their established function." *KSR*, 127 S. Ct. at 1740, 82 USPQ2d at 1396.

In KSR, the Supreme Court emphasized “the need for caution in granting a patent based on the combination of elements found in the prior art,” *id.* At 1739, 82 USPQ2d at 1395, and discussed circumstances in which a patent might be determined to be obvious. In particular, the Supreme Court emphasized that “the principles laid down in *Graham* reaffirmed the obviousness”). However, “the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill would employ.” *Id.* The court cautioned that “[a] factfinder should be aware, of course, of the distinction caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning.” *Id.* At 1742, 82 USPQ2d at 1397.

The court noted that “[in] many fields it may be that there is little discussion of obviousness techniques or combinations, and it often may be the case that market demand, rather than scientific literature, will drive design trends.” KSR, 127 S. Ct. at 1741, 82 USPQ2d at 1396. “Under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.” *Id.* At 1742, 82 USPQ2d at 1397. The Court also noted that “[c]ommon sense teaches...that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle.” *Id.* At 1742, 82 USPQ2d at 1397. “A person of ordinary skill is also a person of ordinary creativity, not an automaton.” *Id.*

Furthermore, the Supreme Court explained that “{w}hen there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp.” KSR, 127 S. Ct. at 1742, 82 USPQ2d at 1397. “If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense,” *id.* And, in such an instance “the fact that a combination was obvious to try might show that it was obvious under §103” *id.*

The level of ordinary skill in the art may be evidenced by the prior art references. In *re* GPAC Inc., 57 F.3d 1573, 1579, 35 USPQ2d 1116, 1121 (Fed. Cir. 1995) (“Although the Board did not make a specific finding on skill level, it did conclude that the level of ordinary skill in the art...was best determined by appeal to the references of record....We do not believe that the Board clearly erred in adopting this approach.”); see also *In re Oelrich*, 579 F.2d 86, 91, 198 USPQ 210, 214 (CCPA 1978) (“the PTO usually must evaluate both the scope and content of the prior art and the level of ordinary skill solely on the cold words of the literature”).

In sustaining a multiple reference rejection under 35 U.S.C. §103(a), the Board may rely on one reference alone without designating it as a new ground of rejection. In *re* Bush, 296 F. 2d 491, 496, 131 USPQ 263, 266-67 (CCPA 1961); in *re* Boyer, 363 F. 2d 455, 458 n. 2, 150 USPQ 441, 444 n.2 (CCPA 1966).

During examination of patent application, a claim is given its broadest reasonable construction consistent with the specification. In *re* Prater, 415 F. 2d. 1393, 1404-05, 162

USPQ 541, 550-51, (CCPA 1969). “[T]he words of a claim ‘are generally given their ordinary and customary meaning.’ “

Phillips v. AWH Corp., 415 F. 3d 1303, 1312, 75 USPQ2d 1321, 1326 (Fed. Cir. 2005) (en banc) (internal citations omitted). The “ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application.” *Id.* At 1313, 75 USPQ2d at 1326.

15. With respect to the remaining claims, the references are combined for the same reasons already applied in the rejection of claim 25.

16. Claim 26 sets forth: “The program of machine-readable instructions according to claim 25, wherein at least one of maintaining the image sensing surface at a variable effective image distance and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.”

See object 28 that is scanned by scanning mirror 28 of Land.

17. Claim 27 sets forth: “The program of machine-readable instructions according to claim 25, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.”

18. Claim 28 sets forth: “The program of machine-readable instructions according to claim 27, wherein maintaining an image sensing surface at a variable effective image distance comprises varying between a first and a second image distance that respectively correspond to the first and second object distances.”

See the rejections of claims 3 and 4 as set forth above in the rejection under 102(b) as anticipated by Land.

19. Claim 33 sets forth: "The program of machine-readable instructions according to claim 25, wherein maintaining an image sensing surface at a variable effective image distance synchronously with exposing operates to impose an effective curvature to the sensing surface, at least a cross section of said effective curvature approximating at least a cross section of a Petzval surface." Petzval curvature correction is described with respect to the prior art, Figure 2 of Land. Given the teaching of the BACKGROUND OF THE INVENTION of Land, the examiner interprets the system of Figure 1 to be free of any aberrations caused by Petzval curvature.

20. Claim 34 sets forth: "The program of machine-readable instructions according to claim 25, wherein the image sensing surface comprises photographic film." Figure 1 of Land shows a strip of film.

21. Claim 36 sets forth: "The program of claim 25, wherein maintaining the image sensing surface at a variable effective image distance from the lens comprises moving the lens relative to the sensing surface."

See Figure 1 of Land in view of the teachings applied in the rejection of claims 1-4, 9 and 10 as set forth above. Both the lens and the sensing surface move relative to one another.

22. Claim 40 is met for the same reasons already applied in the rejection of claim 25 as set forth above.

Double Patenting

23. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory

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obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

24. Claims 1 through 12, 25 through 37 and 40 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1 through of copending Application No. 11/200,267 (U.S. patent Application Publication 2007/0031136 A1, a Notice of Allowance was mailed from the Office on April 30, 2008). Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of the instant application and the claims of the publication use synonymous language to claim essentially the same thing.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

25. A comparison of several of the claims are made for applicant's convenience.

26. Claim 1. "A method for imaging a scene comprising:

1. A method for ~~digitally imaging a scene comprising:~~

manipulating an optical relationship between an optical lens and an image sensing

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surface so that the image sensing surface is spaced at different effective image distances from the lens

providing an imaging lens and a digital image sensing surface for receiving light through the lens; ; and

exposing different portions of the image sensing surface synchronous with manipulating the optical relationship.”

changing a focusing of the imaging lens with respect to the digital image sensing surface in correspondence with a variance of a parameter that relates a captured image at the sensing surface and another image deriving from the captured image.

The examiner asserts that the limitations “changing” and “manipulating” are not distinctly different. Also the limitation “variance of a parameter” reads on “exposure”.

27. Claim 25 sets forth: “A program of machine-readable instructions, tangibly embodied on an information bearing medium and executable by a digital data processor, to perform actions directed toward operating a camera, the actions comprising:

19. A program of machine-readable instructions, tangibly embodied on an information bearing medium and executable by a digital data processor, to perform actions directed toward changing an optical distance between an optical lens and a sensing surface, the actions comprising:

during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of

the sensing surface."

~~correlating changes in focusing a lens with respect to a sensing surface of a digital image capturing component with variance of a parameter that relates an image captured at the sensing surface and another derivative image.~~

The limitations of claim 19 of the publication do not expressly meet the limitation "operating a camera," however the operation of many cameras could include "changing an optical distance between an optical lens and a sensing surface". "Changes in focusing a lens" reads on "variable effective image distance". The examiner associates "synchronously" with "correlating". Any patentable distinctions between the limitations "exposing different portions of the sensing surface" and "another derivative image" are not clear to the examiner.

28. Claim 12 sets forth: "The method of claim 1, wherein manipulating the optical relationship comprises altering a shape of the lens."

~~26. The program of machine readable instructions of claim 20, wherein correlating changes in focusing a lens comprises electronically changing a shape of the lens.~~

Also see claim 9 of the publication.

With respect to the claims that two objects, the limitations "video" and "hyperfocal distance" accommodate images scenes likely to include multiple objects.

Allowable Subject Matter

29. Claims 13 through 16 are allowed.

30. The following is an examiner's statement of reasons for allowance:

Each and every limitation of claim 13 is required to patentably distinguish over the prior art of record.

Claims 14 and 16 depend from claim 13.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

31. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Furlan et al. U.S. Patent Application Publication US 2004/0223075 A1 teaches a digital photography device having a rolling shutter.

Wang et al. U.S. Patent Application Publication US 2006/0202038 A1 teaches a system and method to automatically focus an image reader.

32. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MELISSA J. KOVAL whose telephone number is (571) 272-2121. The examiner can normally be reached on Monday through Friday.

33. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Assouad can be reached on 571-272-2210. The fax phone

Art Unit: 2862

number for the organization where this application or proceeding is assigned is 571-273-8300.

34. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MELISSA J KOVAL/
Primary Examiner, Art Unit 2862

MELISSA J KOVAL
Primary Examiner
Art Unit 2862

MJK

Notice of References Cited	Application/Control No. 11/165,992		Applicant(s)/Patent Under Reexamination KAKKORI, HANNU	
	Examiner MELISSA J. KOVAL		Art Unit 2862	Page 1 of 1

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*	A	US-3,537,373	11-1970	LAND EDWIN H	396/21
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*	D	US-2006/0202038	09-2006	Wang et al.	235/462.24
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
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	O					
	P					
	Q					
	R					
	S					
	T					

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*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1107	396/89.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:14
L2	275	396/335.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:14
L3	316	396/348.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:14
L4	308	396/351.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:14
L5	837	358/302.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:15
L6	887	359/205.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:15
L7	1144	359/212.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:15

L8	739	348/345.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:15
L9	245	348/349.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:15
L10	345	348/296.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:15
L11	652	348/362.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:16
L12	77	348/367.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 14:16
S1	3	"20040217257"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:39
S2	2	"5,745,175".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:39
S3	2	"5,282,045".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:41

S4	2	"6,369,954".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:41
S5	2	"6,445,415".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:42
S6	2	"6,567,126".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:42
S7	2	"6,783,068".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:42
S8	65	digital and (rolling adj shutter) and (integrat\$3 adj period)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:50
S9	25	digital and (rolling adj shutter) and (integrat\$3 adj period) and expos\$3 and lens\$2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:52
S10	1	digital and (rolling adj shutter) and (integrat\$3 adj period) and expos\$3 and lens\$2 and ((image adj sensing) adj surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:55
S11	13	digital and (rolling adj shutter) and (integrat\$3 adj period) and expos\$3 and lens\$2 and (spac\$1 or spacing)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/16 19:56

S12	2	"6,424,786".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/17 11:54
S13	2	"6,244,216".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/17 11:55
S14	2	"6,517,210".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/17 11:55
S15	2	"6,224,216".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/17 13:52
S16	2	"6,224,216".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/18 11:18
S17	333	(lens same film) and (spac \$3 same different) and ((exposure or exposing) same synchronous\$2)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 07:59
S18	70	(lens same film) and (spac \$3 same different) and ((exposure or exposing) same synchronous\$2) and "396"/\$.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:00
S19	1	S17 and (rolling adj shutter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:00

S20	1	S18 and (rolling adj shutter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:01
S21	4	S17 and (image adj distance) and (object adj distance)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:02
S22	15	S17 and (object adj distance)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:03
S23	0	(lens same (photosensitive adj pixels)) and (spac\$3 same different) and ((exposure or exposing) same synchronous\$2)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:09
S24	2	"6,014,524".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:10
S25	12	(lens same film) and (spac\$3 same different) and ((exposure or exposing) same synchronous\$2) and Petzval	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:14
S26	4	"3,537,373".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:22
S27	5	"3,605,592".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 08:23

S28	0	(machine-readable adj instruction\$1) and camera and (digital adj process \$3) and (exposure adj frame) and (lens\$2 or optic\$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:30
S29	0	((machine adj readable) adj instruction\$1) and camera and (digital adj process\$3) and (exposure adj frame) and (lens\$2 or optic\$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:30
S30	1	((machine adj readable) adj instruction\$1) and camera and (digital same process\$3) and (exposure adj frame) and (lens\$2 or optic\$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:31
S31	1	((machine adj readable) same instruction\$1) and camera and (digital same process\$3) and (exposure adj frame) and (lens\$2 or optic\$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:31
S32	325	((machine adj readable) same instruction\$1) and camera and (digital same process\$3) and exposure and (lens\$2 or optic\$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:31
S33	56	((machine adj readable) same instruction\$1) and camera and (digital same process\$3) and exposure and (lens\$2 or optic\$1) and pen	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:33
S34	139	((machine adj readable) same instruction\$1) and camera and (digital same process\$3) and (expos\$3 same (lens\$2 or optic\$1))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:36
S35	135	((machine adj readable) same instruction\$1) and camera and (digital same process\$3) and (expos\$3 same (lens\$2 or optic\$1)) and (media or medium)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:37

S36	2	"20070031136"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:43
S37	102	((machine adj readable) same instruction\$1) and camera and (digital same process\$3) and exposure and ((lens\$2 or optic\$1) same (variable or mov\$3 or movabl\$1))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:50
S38	0	((machine adj readable) same instruction\$1) and camera and (digital same process\$3) and ((exposure or expos\$3) adj synchronous\$2) and ((lens\$2 or optic\$1) same (variable or mov\$3 or movabl\$1))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:54
S39	0	((machine-readable) same instruction\$1) and camera and (digital same process \$3) and ((exposure or expos\$3) adj synchronous \$2) and ((lens\$2 or optic \$1) same (variable or mov \$3 or movabl\$1))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:54
S40	0	((machine-readable) same instruction\$1) and camera and (digital same process \$3) and ((exposure or expos\$3) adj synchronous \$2) and ((lens\$2 or optic \$1) same (variable or (mov\$3 or movabl\$1)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:55
S41	99	((machine-readable) same instruction\$1) and camera and (digital same process \$3) and (exposure or expos\$3) and ((lens\$2 or optic\$1) same (variable or (mov\$3 or movabl\$1)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 18:56
S42	2	"4,484,233".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 19:05

S43	19	("3141106" "3184753" "3210597" "3422218" "3732367" "3786182" "3818131" "3858081" "4027315" "4285587" "4343543").PN. OR ("4484233").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2008/06/24 19:05
S44	0	"4,484,233".pn. and pixel	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 19:25
S45	2	"20060202038"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/24 19:44
S46	0	(first and second) adj (object adj distances) and (brightness adj (two adj objects))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 13:24
S47	0	"200402175257"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 13:50
S48	0	"2004002175257"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 13:51
S49	2	"5,745,175".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 13:51
S50	3	"20040217257"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/06/25 13:52

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BIB DATA SHEET

CONFIRMATION NO. 3430

SERIAL NUMBER 11/165,992	FILING or 371(c) DATE 06/24/2005 RULE	CLASS 396	GROUP ART UNIT 2862	ATTORNEY DOCKET NO. 877.0006.U1(US)		
APPLICANTS Hannu Kakkori, Tampere, FINLAND; ** CONTINUING DATA ***** ** FOREIGN APPLICATIONS ***** ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 07/19/2005						
Foreign Priority claimed <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No 35 USC 119(a-d) conditions met <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Verified and Acknowledged <u>/MELISSA J KOVAL/</u> Examiner's Signature		<input type="checkbox"/> Met after Allowance Initials	STATE OR COUNTRY FINLAND	SHEETS DRAWINGS 6	TOTAL CLAIMS 45	INDEPENDENT CLAIMS 7
ADDRESS HARRINGTON & SMITH, PC 4 RESEARCH DRIVE SHELTON, CT 06484-6212 UNITED STATES						
TITLE Adaptive optical plane formation with rolling shutter						
FILING FEE RECEIVED 3180	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		<input type="checkbox"/> All Fees			
			<input type="checkbox"/> 1.16 Fees (Filing)			
			<input type="checkbox"/> 1.17 Fees (Processing Ext. of time)			
			<input type="checkbox"/> 1.18 Fees (Issue)			
			<input type="checkbox"/> Other _____			
			<input type="checkbox"/> Credit			

Search Notes

Application/Control No.

11/165,992

Examiner

MELISSA J. KOVAL

Applicant(s)/Patent under
Reexamination

KAKKORI, HANNU

Art Unit

2862

SEARCHED

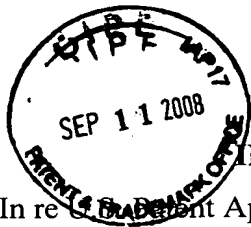
Class	Subclass	Date	Examiner
396	89 335 348 351	6/24/2008	MJK
358	302	6/24/2008	MJK
359	205,212	6/24/2008	MJK
348	345, 349	6/24/2008	MJK
348	296	6/24/2008	MJK
348	362, 367	6/24/2008	MJK

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner

**SEARCH NOTES
(INCLUDING SEARCH STRATEGY)**

	DATE	EXMR
EAST (sheets attached include text search strategy) USPGPUB, USPAT, USOCR, EPO, JPO, IBM_TDB, Derwent, FPRS	6/24/2008	MJK
PLUS search	6/3/2008	MJK
Reviewed 11/200,267	6/24/2008	MJK
Consulted SPE Ometz and Examiners Hannett and Tran regarding class 348.	6/23/2008	MJK



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IN THE U.S. PATENT AND TRADEMARK OFFICE

In re Patent Application of:

APPLICANT : Hannu Kakkori
SERIAL NO. : 11/165,992
FILING DATE : 06/24/2005
EXAMINER : Koval, Melissa J
ART UNIT : 2862 (confirmation number 3430)
DOCKET NO. : 877.0006.U1(US)

TITLE: ADAPTIVE OPTICAL PLANE FORMATION WITH ROLLING SHUTTER

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO OFFICE ACTION

Sir:

In response to the non-final Office Action dated July 1, 2008, the Applicant hereby amends the above-referenced application as follows:

Amendments to the Specification: None.

Amendments to the Drawings: None.

Amendments to the Claims: begins at page 2 of this paper.

Remarks/Arguments: begins at page 8 of this paper.

An **Appendix** is attached following page 9 of this paper; a Terminal Disclaimer.

This Amendment is filed within the shortened statutory period for reply recited in the referenced Office Action, and no petition for time extension, late fee or excess claim fee is seen due. Should the undersigned representative be mistaken, please consider this as a petition for an extension of time necessary to effect his Amendment and/or charge Deposit Account No. 50-1924 for any required fee deficiency.

AMENDMENTS TO THE CLAIMS:

This listing of the claims will replace all prior versions, and listings, of the claims in this application.

1.(Canceled)

2. (Currently Amended) The method of ~~claim 1~~ claim 7, wherein at least one of manipulating the optical relationship and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.

3.(Currently Amended) The method of ~~claim 1~~ claim 7, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.

4.(Currently Amended) The method of ~~claim 1~~ claim 7, wherein manipulating the optical relationship comprises manipulating between a first effective image distance and a second effective image distance, wherein the first and second effective image distances correspond respectively to the first and second object distances.

5. (Currently Amended) ~~The method of claim 1 wherein exposing different portions of the image sensing surfaces comprises~~ A method comprising:
 manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and
 exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.

6.(Currently Amended) ~~The method of claim 1 wherein exposing different portions of the image sensing surface comprises~~ A method comprising:

manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and

exposing different portions of the image sensing surface synchronous with manipulating the optical relationship by adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.

7.(Currently Amended) ~~The method of claim 1~~ A method comprising:

manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and

exposing different portions of the image sensing surface synchronous with manipulating the optical relationship,

wherein the image sensing surface comprises an array of pixels in adjacent rows, wherein a first portion of the array is exposed while the image sensing surface is at a first effective image distance, and a second portion of the array is exposed while the sensing surface is at a second effective image distance, and wherein at least one pixel of the first portion is in ~~the same~~ a same row of the array as at least one pixel of the second portion.

8.(Currently Amended) ~~The method of claim 1,~~ A method comprising:

manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and

exposing different portions of the image sensing surface synchronous with manipulating the optical relationship,

wherein manipulating the optical relationship synchronously with exposing operates to impose an effective curvature to the sensing surface, ~~at least a cross section of said effective curvature approximating at least a cross section of~~ that approximates a Petzval surface.

9.(Canceled)

10.(Currently Amended) ~~The method of claim 1~~ claim 5, wherein the image sensing

surface comprises an array of photosensitive pixels.

11.(Currently Amended) The method of ~~claim 1~~ claim 7, wherein manipulating the optical relationship comprises moving at least one of the lens and the sensing surface relative to one another.

12.(Currently Amended) ~~The method of claim 1,~~ A method comprising:
manipulating an optical relationship between an optical lens and an image sensing surface so that the image sensing surface is spaced at different effective image distances from the lens; and
exposing different portions of the image sensing surface synchronous with
manipulating the optical relationship,
wherein manipulating the optical relationship comprises altering a shape of the lens.

13.(Currently Amended) A method ~~for imaging a scene~~ comprising:
determining a first object distance between a first object in a scene and a lens;
determining a second object distance between a second object in the scene and the lens;
within a continuous exposure frame:
exposing a first portion of an image sensing surface while the image sensing surface is at a first effective image distance from the lens, where the first effective image distance corresponds to the first object distance;
exposing a second portion of the image sensing surface while the image sensing surface is at a second effective image distance from the lens, where the second effective image distance corresponds to the second object distance; and
combining the exposed first and second portions into a single image.

14.(Original) The method of claim 13, wherein the single image is displayed on a digital graphical user interface.

15.(Original) The method of claim 13, wherein exposing the first and second portion of the

image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected brightness of the first and second objects.

16.(Original) The method of claim 13, wherein exposing the first and second portion of the image sensing surface comprises adaptively exposing said portions for a first and second exposure time based on a detected speed of movement of the first and second objects.

17-25.(Canceled)

26.(Currently Amended) The memory of ~~program of machine-readable instructions according to claim 25~~ claim 35, wherein at least one of maintaining the image sensing surface at a variable effective image distance and exposing different portions of the image sensing surface are adaptive to objects in a scene to be imaged at the sensing surface.

27.(Currently Amended) The memory of ~~program of machine-readable instructions according to claim 25~~ claim 35, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions based on at least a detected first and second object distance.

28.(Currently Amended) The memory of ~~program of machine-readable instructions according to claim 27~~ claim 35, wherein maintaining an image sensing surface at a variable effective image distance comprises varying between a first and a second image distance that respectively correspond to the first and second object distances.

29.(Currently Amended) The memory of ~~program of machine-readable instructions according to claim 25~~ claim 35, wherein exposing different portions of the image sensing surface comprises adaptively exposing said portions for different exposure periods based on detected movement of at least two objects.

30.(Currently Amended) The memory of ~~program of machine-readable instructions according to claim 25~~ claim 35, wherein exposing different portions of the image sensing

surface comprises adaptively exposing said portions for different exposure periods based on detected brightness of at least two objects.

31.(Currently Amended) The memory of ~~program of machine-readable instructions according to claim 25~~ claim 35, wherein ~~the image sensing surface comprises an array of pixels for which~~ the program controls exposure of the photosensitive pixels according to rows.

32.(Currently Amended) The memory of ~~program of machine-readable instructions according to claim 25~~ claim 35, wherein ~~the image sensing surface comprises an array of pixels for which~~ the program controls exposure of the photosensitive pixels individually.

33.(Currently Amended) The memory of ~~program of machine-readable instructions according to claim 25~~ claim 35, wherein maintaining an image sensing surface at a variable effective image distance synchronously with exposing operates to impose an effective curvature to the sensing surface, ~~at least a cross section of said effective curvature approximating at least a cross section of~~ that approximates a Petzval surface.

34.(Canceled)

35.(Currently Amended) A memory storing a program of machine-readable instructions, executable by a digital data processor, to perform actions directed toward operating a camera, the actions comprising:

during an exposure frame period, maintaining an image sensing surface at a variable effective image distance from a lens synchronously with exposing different portions of the sensing surface,

~~The program of machine-readable instructions according to claim 25~~, wherein the image sensing surface comprises an array of photosensitive pixels.

36. (Currently Amended) The ~~program~~ memory of ~~claim 25~~ claim 35, wherein maintaining the image sensing surface at a variable effective image distance from the lens

S.N.: 11/165,992

Art Unit: 2862; Confirmation number 3430

comprises moving the lens relative to the sensing surface.

37.(Currently Amended) The ~~program memory~~ of ~~claim 25~~ claim 35, wherein maintaining the image sensing surface at a variable effective image distance from the lens comprises changing a shape of the lens.

38-45.(Canceled)

REMARKS:

Rejections under 35 USC 102(b)

The Examiner rejected claims 1-4 and 8-11 under 35 USC 102(b) as being anticipated by U.S. Patent No. 3,537,373 (Land). Claims 1 and 9 have been cancelled. Claims 5-7 were deemed allowable save for a double patenting rejection (addressed below), and have been rewritten as independent claims. Claim 2-4 and 11 have been amended to depend from rewritten independent claim 7. Claims 10-11 have been rewritten to depend from rewritten independent claim 5. Remarks respecting claim 8 are set forth below.

Rejections under 35 USC 103(a)

The Examiner rejected claims 25-28, 33, 34, 36, and 40 under 35 U.S.C. §103(a) as being obvious over Land in view of Strout (U.S. Patent No. 4,484,233). Claim 35 was deemed allowable save for a double patenting rejection (addressed below), and has been rewritten as an independent claim. Claim 25 has been cancelled. Claims 26-33 and 35-37 have been amended to depend from rewritten independent claim 35. Claims 34 and 40 have been cancelled. Further, the preambles of claim 35 and claims now depending from it are changed to claim the memory rather than a program embodied on a memory/medium, consistent with what appears to be the Patent Office's recent preference.

Rejections under Non-Statutory Double Patenting

The Examiner rejected claims 1-12, 25-37, and 40 on the ground of non-statutory obviousness-type double patenting. A terminal disclaimer under 37 C.F.R. 1.321 is attached.

Allowed Claims:

The office action concluded that claims 13 through 16 are allowed. The preamble of claim 13 is shortened, which is not seen to change the conclusion of patentability.


Comments respecting claim 8:

The examiner stated in the substantive rejection of claim 8 that the Land reference describes Petzval curvature correction. The rejection of claim 8 is seen to imply that in Land, Petzval curvature is corrected along the X' axis since the film moves in that direction (Land, Fig. 2).

Land explicitly states at col. 1 lines 71-75 that the focal field is flat so as to coincide with the plane of the photosensitive material 14 (film). Because Land's moving film is planar, Petzval curvature is seen to be corrected ONLY along the X' axis as shown at Land Fig. 2, and cannot be corrected along the Y' axis of that same film given the mechanical arrangement of Land. Claim 8 is rewritten as an independent claim and amended to remove the formerly recited "at least a cross section" language, now reciting that the imposed effective curvature approximates a Petzval surface. Since a surface cannot be defined only by a line such as the X' axis in Land's Figure 2, claim 8 as amended is seen to patentably distinguish over Land.

All claims presented herein with the exception of claim 8 are seen to recite subject matter that the office action deemed patentably distinct over the cited art. Claim 8 is amended to overcome the rejection, and a terminal disclaimer is attached to address the double patenting issue. As such, all claims are seen to be in condition for allowance. The Examiner is requested to now pass each of claims 2-8, 10-16, 26-33 and 35-37 to issue. The Applicant's representative named below welcomes the opportunity to address any unresolved issue that may remain, formal or otherwise, via teleconference at the Examiner's discretion.

Respectfully submitted:


Jerry Stanton
Reg. No.: 46,008

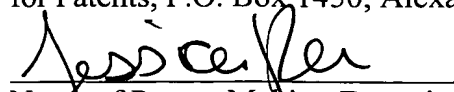
Sep 8, 2008
Date

Customer No.: 29683
HARRINGTON & SMITH, PC
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Shelton, CT 06484-6212

Telephone: (203) 925-9400 ext. 12
Facsimile: (203) 944-0245
E-mail: gstanton@hspatent.com

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.


Name of Person Making Deposit

9-8-2008
Date

SEP 11 2008

**Terminal Disclaimer To Obviate A Double
Patenting Rejection Over A Prior Patent**

Docket No.
877.0006.U1(US)

Inventor Application Of:

Hannu Kakkori

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
11/165,992	06/24/2005	Koval, Melissa J.	29863	2862	3430

Invention:

Adaptive Optical Plane Formation with Rolling Shutter

Owner of Record:

Nokia Corporation

COMMISSIONER FOR PATENTS:

The above-identified owner of record of a 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application, which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. 154 to 156 and 173, as presently shortened by any terminal disclaimer, of prior Patent No. 7,412,158. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors and/or assigns.

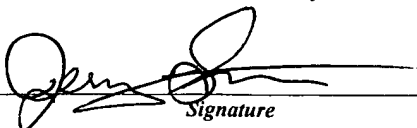
In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 to 156 and 173 of the prior patent, as presently shortened by any terminal disclaimer, in the event that it later expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 C.F.R. 1.321, has all claims cancelled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ For submissions on behalf of an organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the organization.

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

2. ☒ The undersigned is an attorney of record.


Signature

Dated: September 8, 2008

Jerry Stanton (Registration No. 46,008)

Typed or Printed Name

- ☐ Terminal disclaimer fee under 37 C.F.R. 1.20(d) included.
☐ PTO suggested wording for terminal disclaimer was unchanged.
☐ Certification under 37 C.F.R. 3.73(b) is required if terminal disclaimer is signed by the assignee.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 11/165,992		Filing Date 06/24/2005		<input type="checkbox"/> To be Mailed	
APPLICATION AS FILED – PART I										
(Column 1)			(Column 2)		SMALL ENTITY <input type="checkbox"/>		OR		OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE (\$)	FEE (\$)	RATE (\$)	FEE (\$)	RATE (\$)	FEE (\$)	RATE (\$)	FEE (\$)
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A		N/A		N/A		N/A	
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A		N/A		N/A		N/A	
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A		N/A		N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X \$	=	OR	X \$	=	X \$	=	X \$
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X \$	=	OR	X \$	=	X \$	=	X \$
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))	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).									
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))										
* If the difference in column 1 is less than zero, enter "0" in column 2.										
APPLICATION AS AMENDED – PART II										
(Column 1)			(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY	
AMENDMENT	09/11/2008	CLAIMS REMAINING AFTER AMENDMENT	MINUS	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	RATE (\$)	ADDITIONAL FEE (\$)	ADDITIONAL FEE (\$)
Total (37 CFR 1.16(i))	*	25	Minus	**	45	=	0	OR	X \$50=	0
Independent (37 CFR 1.16(h))	*	7	Minus	***	7	=	0	OR	X \$210=	0
<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))										
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))										
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0
(Column 1)			(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY	
AMENDMENT	Total (37 CFR 1.16(i))	CLAIMS REMAINING AFTER AMENDMENT	MINUS	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	RATE (\$)	ADDITIONAL FEE (\$)	ADDITIONAL FEE (\$)
Total (37 CFR 1.16(i))	*	Minus	**	=	=	X \$	=	OR	X \$	=
Independent (37 CFR 1.16(h))	*	Minus	***	=	=	X \$	=	OR	X \$	=
<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))										
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))										
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.										

Legal Instrument Examiner:
/VIKKI SHORT/


This collection of information is required by 37 CFR 1.16. 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 12 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Document code: WFEE

United States Patent and Trademark Office
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PBRITTON	SALE	#00000002	Mailroom Dt: 09/11/2008	501924	11165992
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Application Number 	Application/Control No. 11/165,992	Applicant(s)/Patent under Reexamination KAKKORI, HANNU
Document Code - DISQ		Internal Document – DO NOT MAIL

TERMINAL DISCLAIMER	<input checked="" type="checkbox"/> APPROVED	<input type="checkbox"/> DISAPPROVED
Date Filed : 9/11/08	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
Janice Ford 7412158

U.S. Patent and Trademark Office



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NOTICE OF ALLOWANCE AND FEE(S) DUE

29683 7590 12/11/2008

HARRINGTON & SMITH, PC
4 RESEARCH DRIVE, Suite 202
SHELTON, CT 06484-6212

EXAMINER

KOVAL, MELISSA J

ART UNIT

PAPER NUMBER

2862

DATE MAILED: 12/11/2008

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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11/165,992

06/24/2005

Hannu Kakkori

877.0006.U1(US)

3430

TITLE OF INVENTION: ADAPTIVE OPTICAL PLANE FORMATION WITH ROLLING SHUTTER

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	03/11/2009

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

29683 7590 12/11/2008

HARRINGTON & SMITH, PC
 4 RESEARCH DRIVE, Suite 202
 SHELTON, CT 06484-6212

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/165,992	06/24/2005	Hannu Kakkori	877.0006.U1(US)	3430

TITLE OF INVENTION: ADAPTIVE OPTICAL PLANE FORMATION WITH ROLLING SHUTTER

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	03/11/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
KOVAL, MELISSA J	2862	396-065000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
- (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____
- 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s); (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

This collection of information is required by 37 CFR 1.311. 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 12 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/165,992	06/24/2005	Hannu Kakkori	877.0006.U1(US)	3430
29683	7590	12/11/2008	EXAMINER	
HARRINGTON & SMITH, PC 4 RESEARCH DRIVE, Suite 202 SHELTON, CT 06484-6212			KOVAL, MELISSA J	
			ART UNIT	PAPER NUMBER
			2862	
DATE MAILED: 12/11/2008				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 484 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 484 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability**Application No.**

11/165,992

Applicant(s)

KAKKORI, HANNU

Examiner

MELISSA J. KOVAL

Art Unit

2862

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the Amendment of September 11, 2008.
2. ☒ The allowed claim(s) is/are 2-8,10-16,26-33 and 35-37(now renumbered 1-25).
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
- * Certified copies not received: ____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date ____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date ____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)


1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date 11/6/2006&6/24/2005
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413),
Paper No./Mail Date ____.
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
1. 9. ☒ Other The terminal disclaimer filed on September 11, 2008 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of 7,412,158 has been reviewed and is accepted. The terminal disclaimer has been recorded.

/MELISSA J KOVAL/ Primary Examiner, Art Unit 2862	
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U.S. Patent and Trademark Office
PTOL-37 (Rev. 08-06)


Notice of Allowability

Part of Paper No./Mail Date 20081202

<i>Index of Claims</i> 	Application/Control No. 11165992	Applicant(s)/Patent Under Reexamination KAKKORI, HANNU
	Examiner MELISSA J KOVAL	Art Unit 2862


✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant			<input type="checkbox"/> CPA			<input type="checkbox"/> T.D.			<input type="checkbox"/> R.1.47		
CLAIM		DATE									
Final	Original	12/02/2008									
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5	2	=									
6	3	=									
7	4	=									
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23	33	=									
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15	35	=									
24	36	=									

<i>Index of Claims</i> 	Application/Control No. 11165992	Applicant(s)/Patent Under Reexamination KAKKORI, HANNU
	Examiner MELISSA J KOVAL	Art Unit 2862

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant			<input type="checkbox"/> CPA			<input type="checkbox"/> T.D.			<input type="checkbox"/> R.1.47		
CLAIM		DATE									
Final	Original	12/02/2008									
25	37	=									
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	39	-									
	40	-									
	41	-									
	42	-									
	43	-									
	44	-									
	45	-									

Search Notes 	Application/Control No. 11165992	Applicant(s)/Patent Under Reexamination KAKKORI, HANNU
	Examiner MELISSA J KOVAL	Art Unit 2862

SEARCHED			
Class	Subclass	Date	Examiner
396	65,89,335,348,351	12/6/2008	MJK
359	205,212,666,708,721	12/6/2008	MJK
358	302	12/6/2008	MJK
348	296,345,349,362,367	12/6/2007	MJK

SEARCH NOTES		
Search Notes	Date	Examiner
EAST (sheets attached include text search strategy) USPGPUB, USPAT, USOCR, EPO, JPO, IBM_TDB, Derwent, FPRS	12/6/2008	MJK
Inventor search in EAST and PALM	12/7/2008	MJK

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
396	65,89,335	12/6/2008	MJK
359	666,708,721	12/6/2008	MJK
348	207.99	12/6/2008	MJK

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Serial No.:

Group: 2862

[illegible][illegible]

Date Considered: 06/25/2008

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered.
Include a copy of this citation form with your next correspondence to the Applicant(s).

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	133	396/65.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:07
L2	1121	396/89.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:07
L3	278	396/335.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:07
L4	309	359/666.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:07
L5	971	359/708.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:07
L6	306	359/721.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:07
L7	1422	348/207.99.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:08

L8	320	396/348.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:08
L9	310	396/351.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:08
L10	922	359/205.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:08
L11	1168	359/212.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:08
L12	842	358/302.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:09
L13	362	348/296.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:09
L14	797	348/345.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:09
L15	270	348/349.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:09

L16	686	348/362.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:09
L17	82	348/367.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:10
L18	1	lens\$2.clm. and (image adj sens\$3). clm. and distance\$1. clm. and (exposure\$1 or expos\$3).clm. and Kakkori.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:12
L19	20	Kakkori.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:12
L20	2	Kakkori.in. and (rolling adj shutter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/07 07:12
S1	4	"7,412,518".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/06 10:14
S2	4	"7,412,158".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/06 10:14
S3	141	lens\$2.clm. and (image adj sens\$3). clm. and distance\$1. clm. and (exposure\$1 or expos\$3).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/06 21:57

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S6	53	((lens\$2 and (image adj sens\$3)) same ((spac\$3 or different) adj distance\$1))) and (exposure\$1 or expos \$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/06 22:00
S7	6	((lens\$2 and (image adj sens\$3)) same ((spac\$3 or different) adj distance\$1))) same (exposure\$1 or expos \$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/06 22:01
S8	4	((different adj effective \$2) adj (image adj distanc\$3))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2008/12/06 22:08
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12/ 7/ 2008 7:15:56 AM

C:\ Documents and Settings\ mkoval\ My Documents\ EAST\ Workspaces\ 11165992.wsp



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 11/165,992 Confirmation No.: 3430
Applicant(s): Hannu Kakkori
Filed: 06/24/2005
Art Unit: 2851
Examiner:
Title: Adaptive Optical Plane Formation With Rolling Shutter

Attorney Docket No.: 877.0006.U1(US)
Customer No.: 29,683

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

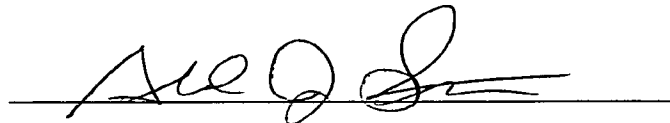
The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the documents listed on the enclosed Form PTO-1449. Copies of the non-US documents are enclosed with the Form PTO-1449 for the Examiner's use. The documents listed were cited in an International Search Report issued in the corresponding International Application (PCT/IB2006/001507). A copy of the Search Report is attached.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the

claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

Respectfully submitted,



Gerald J. Stanton (Reg. No. 46,008)

Nov 1, 2006

Date

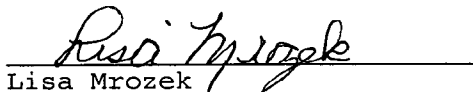
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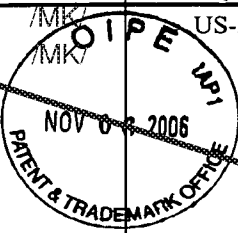
Harrington & Smith, LLP
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

CERTIFICATE OF MAILING


I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

11/01/2006
Date


Lisa Mrozek

INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute)		Docket No.: 877.0006.U1(US) Applicant(s): Hannu Kakkori Filing Date: 06/24/2000		Serial No.: 11/165,992 Group: 2851 2862	
U.S. PATENT DOCUMENTS					
Examiner Initials	Document Number (Number-Kind Code)	Publication Date (MM-DD-YYYY)	Name of Patentee or Applicant	Class	Sub-class
	US-2004-0217257 A1	11-04-2004	Fiete et al.	250	201.7
	US-5,745,175	04-28-1998	Anderson	348	345
	US-				
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	US-				
FOREIGN PATENT DOCUMENTS					
Examiner Initials	Document Number (Country Code-Number-Kind Code)	Publication Date (MM-DD-YYYY)	Name Of Patentee of Applicant	Translation? Yes/No/n/a	
/MK/	JP-2003-131115A	05-08-2003	Minolta Co Ltd	Abstract	
	- -				
	- -				
	- -				
	- -				
	- -				
OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)					
Examiner's Signature: /Melissa Koval/			Date Considered: 06/25/2008		
Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).					

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /MK/

Issue Classification 	Application/Control No. 11165992	Applicant(s)/Patent Under Reexamination KAKKORI, HANNU
	Examiner MELISSA J KOVAL	Art Unit 2862

ORIGINAL						INTERNATIONAL CLASSIFICATION											
CLASS		SUBCLASS				CLAIMED					NON-CLAIMED						
396		65				G	0	3	B	3 / 00 (2006.01.01)		H	0	4	N	5 / 225 (2006.01.01)	
CROSS REFERENCE(S)						G	0	3	B	7 / 00 (2006.01.01)							
						G	0	2	B	1 / 06 (2006.01.01)							
						G	0	2	B	3 / 12 (2006.01.01)							
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					G	0	2	B	3 / 12 (2006.01.01)							
396	89	335				G	0	2	B	13 / 02 (2006.01.01)							
359	666	708	721			G	0	2	B	13 / 18 (2006.01.01)							
348	207.99					G	0	2	B	3 / 10 (2006.01.01)							

<input type="checkbox"/> Claims renumbered in the same order as presented by applicant <input type="checkbox"/> CPA <input checked="" type="checkbox"/> T.D. <input type="checkbox"/> R.1.47															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
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14	16	22	32												

NONE		Total Claims Allowed:	
		25	
(Assistant Examiner)	(Date)	O.G. Print Claim(s)	O.G. Print Figure
/MELISSA J KOVAL/ Primary Examiner.Art Unit 2862	12/6/2008	1	6
(Primary Examiner)	(Date)		

PART B - FEE(S) TRANSMITTAL

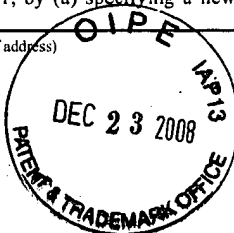
Complete and send this form, together with applicable fee(s), to: **Mail** Mail Stop ISSUE FEE
 Commissioner for Patents
 P.O. Box 1450
 Alexandria, Virginia 22313-1450
 or **Fax** (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

29683 7590 12/11/2008

HARRINGTON & SMITH, PC
 4 RESEARCH DRIVE, Suite 202
 SHELTON, CT 06484-6212



Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Gail Conway	(Depositor's name)
<i>Gail Conway</i>	(Signature)
Dec. 17, 2008	(Date)

12/24/2008 SSESHE2 00000032 501924 11165992

01 FC:1501 1510.00 DA
 02 FC:1504 300.00 DA

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/165,992	06/24/2005	Hannu Kakkori	877.0006.U1(US)	3430

TITLE OF INVENTION: ADAPTIVE OPTICAL PLANE FORMATION WITH ROLLING SHUTTER

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	03/11/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
KOVAL, MELISSA J	2862	396-065000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

Harrington & Smith, PC

2

3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Nokia Corporation

Espoo, Finland

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

☒ Issue Fee

☒ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

☐ A check is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 50-1924 (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature

Jerry Stanton

Date

December 17, 2008

Typed or printed name

Jerry Stanton

Registration No.

46,008

This collection of information is required by 37 CFR 1.311. 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 12 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/165,992	02/17/2009	7493030	877.0006.U1(US)	3430

29683 7590 01/28/2009

HARRINGTON & SMITH, PC
4 RESEARCH DRIVE, Suite 202
SHELTON, CT 06484-6212

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 484 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Hannu Kakkori, Tampere, FINLAND;



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	PATENT NUMBER	GROUP ART UNIT	FILE WRAPPER LOCATION
11/165,992	7493030	2862	9200



Correspondence Address/Fee Address Change

The following fields have been set to Customer Number 10948 on 11/15/2010

- Correspondence Address
- Power of Attorney Address

The address of record for Customer Number 10948 is:

10948
Harrington & SMith , Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
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In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been
filed in the U.S. District Court Western District of Texas on the following

☐ Trademarks or ☒ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO. 6:22-cv-00166	DATE FILED 2/16/2022	U.S. DISTRICT COURT Western District of Texas
PLAINTIFF WSOU Investments, LLC d/b/a Brazos Licensing and Development		DEFENDANT Canon Inc. and Canon U.S.A., Inc.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 7,493,030	2/17/2009	WSOU Investments, LLC d/b/a Brazos Licensing and Development
2		
3		
4		
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY <input type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
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Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy