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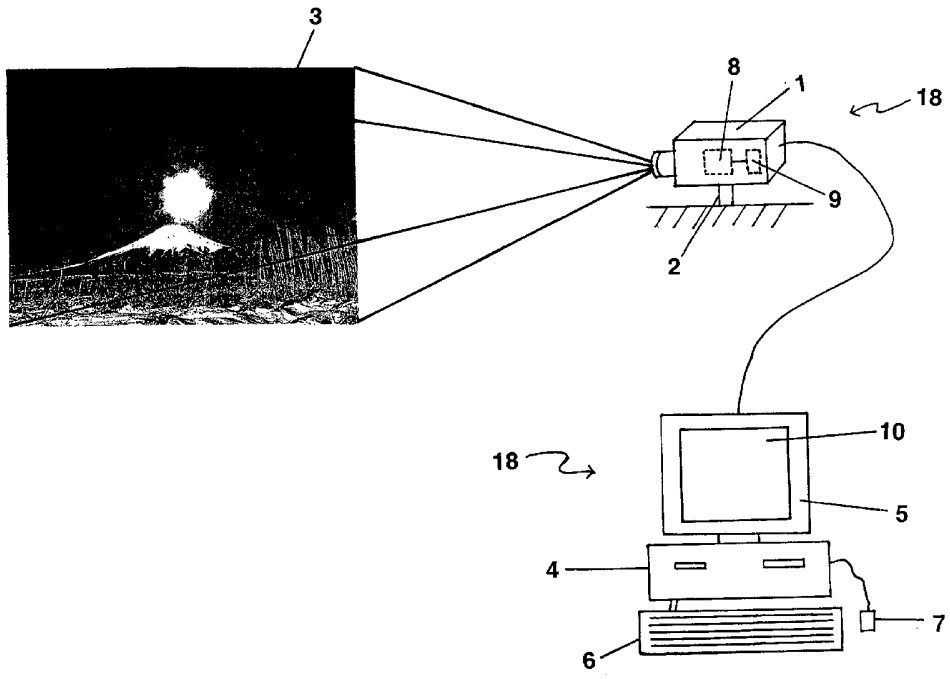
(54) Title: CAMERA METERING AND EXPOSURE CONTROL SYSTEM



(57) Abstract: According to one embodiment, the invention provides a light metering system for metering an image scene subdivided into a plurality of regions; characterised in that a brightness measurement is calculable from a combination of regions, said combination being user definable by selecting or de-selecting one or more said regions. The invention further comprises a camera system employing said metering system and a method for operating same.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Camera metering and exposure control system

The present invention relates generally to a system for controlling the exposure for an electronic imaging device and in particular cameras located in static positions.

BACKGROUND ART

Most imaging devices capable of providing an automatic exposure control utilise information from various settings to calculate the appropriate exposure. In typical photographic film cameras, the settings include the intensity of light transmitted through the lens assembly, the light sensitivity of the film together with the exposure time. However, even cameras with full automatic exposure control, ie control over all the above settings, further information is required regarding the intensity or reflectivity of a light reflected from the photograph scene. An electronic sensor typically detects light reflected from scene either through the same optical lens used to form the photograph image or via a separate dedicated lens.

Electronic cameras are basically capable of varying the same settings and measuring the same perimeters as photographic film cameras. In both electronic and photographic film cameras, the relationship between the portion(s) and locations of the scene used to provide information regarding the brightness or intensity of a scene in comparison with the total field of view of the camera is described as the light metering pattern.

The manner in which the said metering pattern is defined varies according to the intended application, skill/experience of the camera operator, differences in the light characteristics of the photograph scene together with variation between manufacturers in the perceived optimum metering patterns. Notwithstanding the aforesaid, there are four main metering patterns;

- average metering - light from approximately the entire field of view of the image is summed and an arithmetic mean taken;

- centre weighted average metering - an increased emphasis or weighting is applied to points closest to the field of view centre, based on the assumption that the object requiring the most accurate exposure will be placed in the centre of the scene;

- spot metering - the automatic exposure calculation is based on the light metered solely from a small percentage of the image (typically 2-5%) in the centre of the image field of view. Some cameras allow spot metering to be taken for various off centre axis locations prior to composing the final scene and the information stored whereupon it is used to calculate the exposure for the recomposed picture;

- matrix metering – a predetermined pattern of small regions spread throughout the field of view are used to compile an average reading. The distribution and weighting given to the various regions varies between manufacturers and is often kept as a proprietary commercial secret. This type of metering requires the greatest computational power of a microprocessor system associated with the camera, which may include thousands of pre-programmed scenarios which are used by the microprocessor to evaluate the best setting. However, there is no user control on which pattern to use nor typically is there any information provided regarding what the actual metering pattern is.

The primary purpose of the above metering patterns with the exception of simple average metering is to reduce the impact of disproportionally bright or dark regions of the scene. Such regions can fool the automatic exposure calculation of the camera into assuming that the whole scene is actually brighter or darker than in reality and therefore under or over expose the resulting picture.

A further assumption inherent to known metering systems is based on the reflectivity

of the viewed scene. The majority of metering systems work on the assumption that a default scene has a reflectivity of approximately 18% and calculates the exposure accordingly. Consequently, scenes with a large proportion of highly reflective surfaces such as snow scenes, large expanses of water or bright light sources and so forth can lead to the images being underexposed. This may be seen in many pictures of snow scapes where the snow is depicted with a cool blue colour instead of a more realistic bright white appearance.

As centre weighted metering and spot metering both depend on the subject of interest being located primarily in the centre of the image, it follows that the camera orientation must be adjustable to correctly frame the subject. Correspondingly, these metering methods are not appropriate for fixed position cameras such as those used in security/surveillance applications.

Matrix metering is an approximation technique primarily designed to compensate for fluctuating scenes such as those encountered with dynamic activities, eg sport, action and so forth. Again, such circumstances are not typically found in fixed position camera applications and combined with the lack of user control over the distribution of the metered regions, matrix metering leads to shortcomings for static camera usage.

Although average metering would appear to provide a suitable solution for static camera use, this does not avoid the above described difficulty of disproportionally bright or dark areas adversely impacting the exposure of the whole scene nor any miscalculations due to an erroneous assumption of an 18% reflectance of the scene.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

The present invention provides a method of exposure control in a camera, using a metering system including:

- dividing an image scene into a plurality of regions;
- measuring the individual brightness of said regions;
- selecting one or more regions;
- calculating an exposure from the measured brightness of said selected regions.

Preferably said method includes optionally de-selecting one or more selected areas.

According to a further aspect of the present invention, there is provided a light metering system for metering an image scene subdivided into a plurality of regions; characterised in that a brightness measurement is calculable from a combination of regions, said combination being user definable by selecting or deselecting one or more said regions.

According to a further aspect of the present invention, there is provided a camera, including:

- a display apparatus, capable of displaying an image scene acquired by the camera;
- an exposure calculation device, capable of calculating an exposure setting based on predetermined exposure parameters, including a brightness measurement of said image scene;
- photometric detectors capable of determining the said brightness of the image scene and representing same on said display apparatus,

characterised in that said display apparatus is subdivided into a plurality of regions, capable of individual selection or de-selection by a user wherein said exposure setting calculations includes a brightness measurement parameter based solely on said selected regions.

According to one embodiment, said configuration display apparatus may be a computer display, wherein said camera is communicatively coupled to a computer system with a user interface enabling a user to select or de-select said regions displayed on said computer display coupled to said computer system.

The present invention is ideally suited to applications (such as the use of static security cameras) requiring the monitoring or surveillance of defined areas where the image scene incorporates regions of excessive brightness, darkness or reflectivity.

However, by virtue of the present invention, the camera may be configured to exclude the problematic regions of the image scene covering the excessively bright or dark areas. Thus, features such as light bulbs, windows, and so forth may be excluded by the user from the regions of the image scene used to complete the exposure.

The term 'camera' is primarily, though not exclusively, used to denote an electronic camera (both stills and video), capable of producing an electronic display of the image scene, thus permitting the aforesaid manipulations of the regions utilised for the exposure calculation.

It will be appreciated however, that such a configurable display may be interfaced with non-electronic imaging cameras and other image systems by means of suitable acquisition of the respective image scene in known manner.

The term image scene refers to the image, or at least a portion thereof, captured by the relevant acquisition means of the camera for recording and/or display purposes. It will be appreciated that in some instances the image displayed by some camera systems can

differ from the actual image scene (in size, intensity, colour, perspective and so forth) due to either inherent characteristics of the display or by deliberate camera design. Nevertheless, such variations do not affect the nature nor scope of the present invention.

According to an alternative embodiment said display apparatus is formed as an integral part of the camera.

Alternatively, a single display apparatus may be located remote from, and provide exposure control for, one or more cameras.

According to one embodiment, said display apparatus may also be used to view the image scene resulting from said exposure setting calculation.

According to a further aspect of the present invention, said regions are composed of a plurality of fundamental image resolution elements/pixels herein referred to as clusters.

Preferably, said the mean brightness of said clusters is calculated prior to said exposure control calculation based on said selected regions.

It will be appreciated that a regular grid-like subdivision of the image scene would provide a flexible and unrestrictive means of selecting the desired areas of the image scene to effect a desirable exposure. However, it will be further appreciated that any configuration of subdivision may be employed without departing from the scope of the invention.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 shows a schematic representation camera system incorporating a

preferred embodiment of the present invention;

Figure 2 shows an enlarged view of a configuration interface according to a preferred embodiment, and

Figure 3 shows an enlarged view of the image scene shown in figure 2.

BEST MODES FOR CARRYING OUT THE INVENTION

Figure 1 shows a first preferred embodiment of the present invention in which a camera (1) located in an essentially static location on a mounting (2) is orientated to monitor a particular scene (3).

The camera (1) is communicably connected to a computer system (4) interfaced to a display apparatus in the form of a computer display (5) and a user interface in the form of a keyboard (6) and a mouse (7). It should be appreciated that all the components shown in figure 1 are schematic representations used for exemplary purposes only and are not intended to be in any way limiting.

The camera (1) is an electronic CCD (charge coupled device) or CMOS sensor camera and contains a photometric detectors (8) and an exposure calculation device (9). However, the exposure calculation device (9) need not necessarily located within the actual housing of the camera (1) and may instead be located remotely – e.g., in the computer (4). Moreover, the exposure calculation device may not necessarily be a distinct device but may for example be represented in software located in the computer (4).

Although shown as a PC-type of computer (4), it should be appreciated that computer (4) may take any convenient form, including that of a dedicated surveillance camera monitoring unit, optionally receiving inputs from multiple cameras (4).

The computer display (5) displays an image scene (10) captured by the camera (4)

viewing scene (3). Display (5) also provides a visual display of a configuration interface (11) (as shown in figure 2) which permits, amongst other features, the exposure of the image scene (10) to be adjusted. User inputs to the configuration interface (11) may be effected by either the keyboard (6) and/or mouse (7).

The photometric detectors (8) provide a brightness measurement of the image scene (10) as an input to the exposure calculation devices (9). The exposure of the image scene (10) is calculated in known manner by the exposure calculation devices (9) based on a number of predetermined exposure parameters including the calculated brightness measurement of the image scene (10), the camera aperture setting and so forth.

As is well established in photography, objects of excessive brightness, or darkness, or of unusually high reflectivity can lead to a poor exposure of image scene (10). Several different metering system are known, each attempting to provide a means of optimising the exposure against the above described detrimental effects.

Figure 2 shows an enlarged view of a computer screen snap-shot of the configuration interface (11). In the embodiment shown, the configuration interface (11) incorporates a number of selectable menu tabs, with the 'Autoexposure' tab (12) being selected. The selectable or variable options contained within the Autoexposure tab (12) include a variable 'Exposure Compensation' sliding scale (13), an option (14) to define the frequency of a flickering light that may form part of the image scene (10), and a reduced scale display (15) of the image scene (10). The representation shown on display (15) in figure 2 corresponds to the image (3) acquired by the camera (1) and comprises a landscape with a large expanse of cloudless sky, a grass/earth fore-mid ground with a strip of snow at the foot of the scene and a snow-peaked volcano in the picture centre.

A bright sun is located adjacent to the volcano peak. Consequently, there are several

regions of unusually high brightness and/or reflectivity present in the image scene (10). Utilising conventional exposure metering techniques would typically result in an under-exposed picture. This would be due to both the reflectivity of the snow regions being significantly higher than the normally assumed 18% and to the heightened brightness readings from the sun and the snow.

To address this difficulty, the present invention provides a flexible means of adjusting the exposure calculated to take account of any brightness abnormalities as described above.

Figure 3 shows an enlarged view of the display (15) omitting the remainder of the configuration display shown in figure 2. The image scene (10) in display (15) is subdivided into a plurality of regions (16) by a square grid (17).

The grid (17) is shown in figure 3 to illustrate the means of operation, though in practice, the grid (17) need not be visible.

To configure the exposure of the image scene (10), the brightness of certain portions of the scene may be excluded in a user-selectable manner. Instead of using 'average metering' of the whole image scene (10) or spot, centre, or matrix metering – together with their attendant short-comings (as discussed previously), the light metering system (18) provides a means for a user to exclude problematic portions of the image scene (10) from inclusion as an input to the exposure calculation device (9). Metering system (18) includes both the photometric detectors (8) which provide the quantitative measurement of the image scene (10) brightness, and the configuration interface (11) insofar as these relate to exposure metering.

Using either the keyboard (6) or, the mouse (7), a user is able to select individual regions (16) or de-select a previously selected region (16). Only the selected regions (16) are used by the metering system (18) as part of the brightness measurement input to the exposure calculation device (9). If, as in the scene shown in figure 3, the image

scene (10) does include areas of extreme brightness, darkness or reflectivity, these may simply be excluded from the exposure calculation.

In figure 3, the regions (16) selected by the user are shown with a cross bisecting diagonally opposing corners. As may be seen, the user has omitted to include the portions of snow within the scene and the bright sun image. The brightness measurement of the image scene (10) may be simply calculated by averaging the selected regions (10).

Alternative means of displaying to a user that a particular region is selected includes sum of the use of different colours, shading, symbols and so forth. Such markings are only visible on the configuration interface (11) and not on the resultant exposed image viewed after the metering parameters have been defined.

The exposure calculation will be performed only on the selected areas resulting in the correct representation of the remainder of the scene without, for example, obliterating the foreground detail in an over exposed image.

It will be readily apparent that landscape scenes such as that depicted in figures 1-3 would be unlikely to be the object of interest for security monitoring purposes. In practice, typical scenes of interest such as rooms, hallways, yards, outbuildings, and so forth would often include regions of high contrast and bright light sources. As security cameras are often required to cover a specific field of view, it is not usually practical or convenient to realign the camera to enable spot or centre-weighted type metering to be effective. The present invention allows the easy manipulation of the regions (16) metered, thus avoiding the inclusion of unwanted portions of the image scene (10).

The grid (17) shown in figure 3 is made deliberately coarse to aid in clarification and understanding of the mode of operation. However, in practice, the individual region (16) sizes may be produced in any convenient size.

In one embodiment, each of the regions (16) may be configured to include a plurality or bundle of pixels or whatever fundamental element is used to define the resolution of the camera.

Known image compression techniques utilise a means of breaking down the image into bundles of pixels (e.g. 16 x 16) and assign the mean brightness value of the whole bundle to all pixels in the bundle. This type of pre-processing of the image scene (10) can be utilised (if present) to reduce the computational requirements of the exposure calculation. Instead of calculating the exposure based on the individual intensity readings of each selected pixel, the mean value of the corresponding bundle may be utilised instead. Whilst this technique limits the resolution i.e. the size of the selectable regions (16), it does reduce the computational overhead on the system.

Although eminently suited for use with fixed/static cameras or those with a limited movement arc, the present invention may be also utilised in other cameras or imaging systems.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

CLAIMS:

1. A method of exposure control in a camera, using a metering system including:

   - dividing an image scene into a plurality of regions;
   - measuring the individual brightness of said regions;
   - selecting one or more regions;
   - calculating an exposure from the measured brightness of said selected regions.

2. The method as claimed in claim 1, further including optionally de-selecting one or more selected areas.

3. A camera, including:

   - a display apparatus, capable of displaying an image scene acquired by the camera;
   - an exposure calculation device, capable of calculating an exposure setting based on predetermined exposure parameters, including a brightness measurement of said image scene;
   - photometric detectors capable of determining the said brightness of the image scene and representing same on said display apparatus,

   characterised in that said display apparatus is subdivided into a plurality of regions, capable of individual selection or de-selection by a user wherein said exposure calculations includes a brightness measurement parameter based solely on said selected regions.

4. The camera as claimed in claim 3, wherein said display apparatus is a computer

display

5. The camera as claimed in claim 3 or claim 4 wherein said camera is communicatively coupled to a computer system including a user interface enabling a user to select or de-select said regions displayed on said computer display coupled to said computer system.

6. The camera as claimed in claim 3, wherein said display apparatus is formed as an integral component of the camera.

7. The camera as claimed in claim 3, wherein a single display apparatus is located remote from, and provides exposure control for, one or more cameras.

8. The camera as claimed in any one of claims 3-7, wherein said display apparatus may also be used to view the image scene resulting from said exposure setting calculation.

9. The camera as claimed in any one of claims 3-8, wherein said regions are composed of a plurality of fundamental image resolution elements/pixels herein referred to as clusters.

10. The camera as claimed in any one of claims 3-9, wherein a mean brightness of said clusters is calculated prior to said exposure setting calculation based on said selected regions.

11. The camera as claimed in any one of claims 3-10, wherein said subdivided regions form a regular grid over the image scene.

12. The camera as claimed in claim 11, wherein said subdivided regions are irregular in shape and/or area.

13. A light metering system for metering an image scene subdivided into a plurality of regions; characterised in that a brightness measurement is calculable from a

combination of regions, said combination being user definable by selecting or deselecting one or more said regions.

14. The light metering system claimed in claim 13, wherein said image scene is displayed on a display apparatus

15. The light metering system claimed in claim 14, wherein display apparatus is a computer display

16. The light metering system claimed in any one of claims 14-15, wherein said light metering system is communicatively coupled to a computer system including a user interface enabling a user to select or de-select said regions displayed on said computer display coupled to said computer system.

17. The light metering system claimed in claim 14, including a single display apparatus located remote from, and providing exposure control for, one or more cameras.

18. The light metering system claimed in any one of claims 13-17, wherein said regions are composed of a plurality of fundamental image resolution elements/pixels herein referred to as clusters.

19. The light metering system claimed in claim 18, wherein a mean brightness of said clusters is calculated prior to said exposure setting calculation based on said selected regions.

20. The light metering system claimed in any one of claims 13-19, wherein said regions form a regular grid over the image scene.

21. The light metering system claimed in any one of claims 13-19, wherein said regions are irregular in shape and/or area.

22. A camera substantially as hereinbefore described, with reference to, and as

shown in the drawings.

23. A light metering system substantially as hereinbefore described, with reference to, and as shown in the drawings.

AMENDED CLAIMS

[received by the International Bureau on 20 December 2002 (20.12.02)];

Claims 1-13 and claims replaced

1. A method of exposure control in a camera, using a metering system including:

   - dividing an image scene into a plurality of regions;
   - measuring the individual brightness of said regions;
   - a user selecting one or more regions;
   - calculating an exposure from the measured brightness of said selected regions.

2. The method as claimed in claim 1, further including optionally de-selecting one or more selected areas.

3. A camera, including:

   - a display apparatus, capable of displaying an image scene acquired by the camera;
   - an exposure calculation device, capable of calculating an exposure setting based on predetermined exposure parameters, including a brightness measurement of said image scene;
   - photometric detectors capable of determining the said brightness of the image scene and representing same on said display apparatus,

   characterised in that said display apparatus is subdivided into a plurality of regions, capable of individual selection or de-selection by a user wherein said exposure calculations includes a brightness measurement parameter based solely on said selected regions.

4. The camera as claimed in claim 3, wherein said display apparatus is a computer

combination of regions, said combination being definable by a user selecting or deselecting one or more said regions.

The light metering system claimed in claim 13, wherein said image scene is displayed on a display apparatus

The light metering system claimed in claim 14, wherein display apparatus is a computer display

The light metering system claimed in any one of claims 14-15, wherein said light metering system is communicatively coupled to a computer system including a user interface enabling a user to select or de-select said regions displayed on said computer display coupled to said computer system.

The light metering system claimed in claim 14, including a single display apparatus located remote from, and providing exposure control for, one or more cameras.

The light metering system claimed in any one of claims 13-17, wherein said regions are composed of a plurality of fundamental image resolution elements/pixels herein referred to as clusters.

The light metering system claimed in claim 18, wherein a mean brightness of said clusters is calculated prior to said exposure setting calculation based on said selected regions.

The light metering system claimed in any one of claims 13-19, wherein said regions form a regular grid over the image scene.

The light metering system claimed in any one of claims 13-19, wherein said regions are irregular in shape and/or area.

A camera substantially as hereinbefore described, with reference to, and as

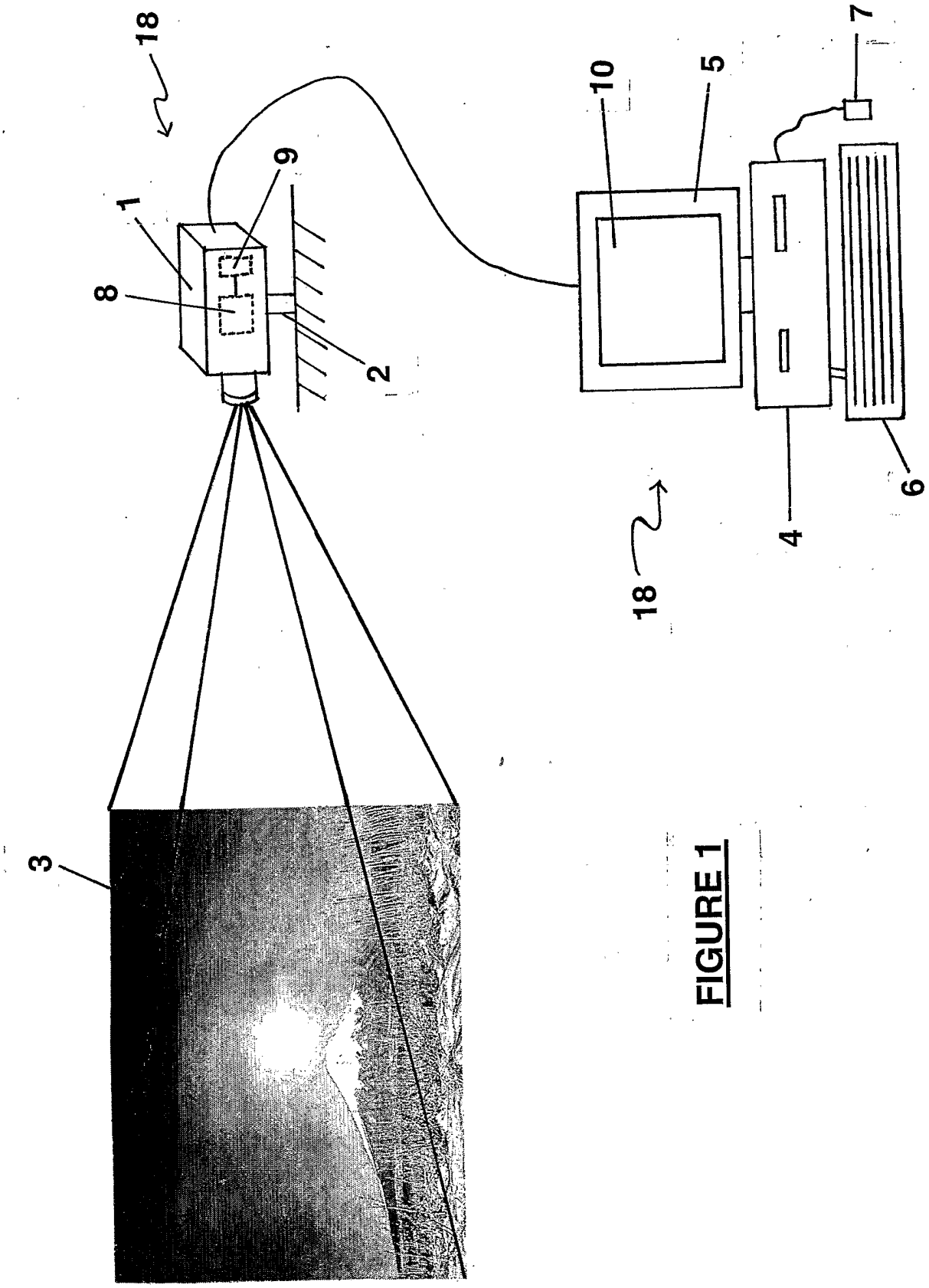

FIGURE 1

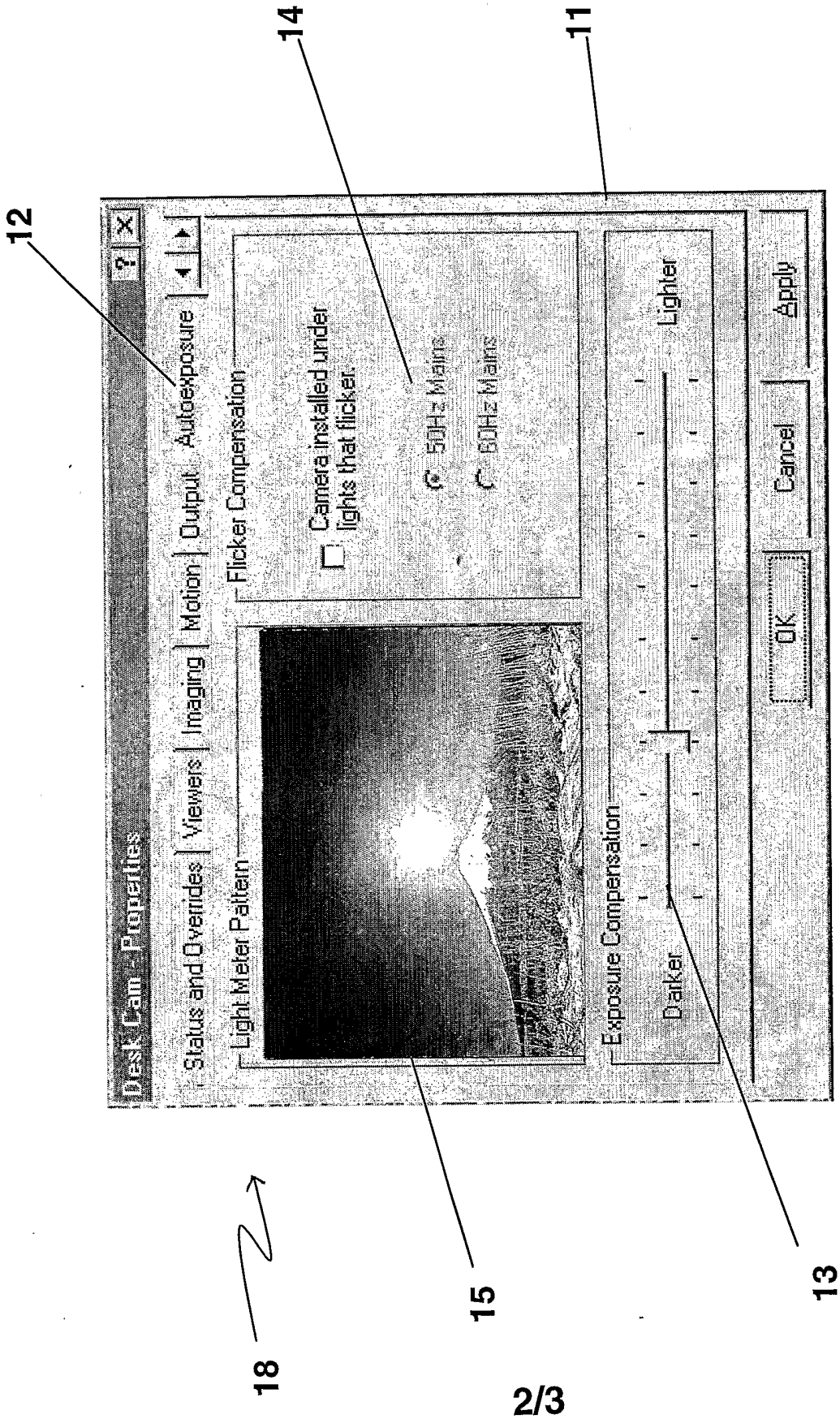
12
14
11
15
13
18
Status and Overrides
Viewers
Imaging
Motion
Output
Autoexposure
Light Meter Pattern
Flicker Compensation
Camera installed under lights that flicker
50Hz Mains
60Hz Mains
Exposure Compensation
Darker
Lighter
OK
Cancel
Apply

FIGURE 2

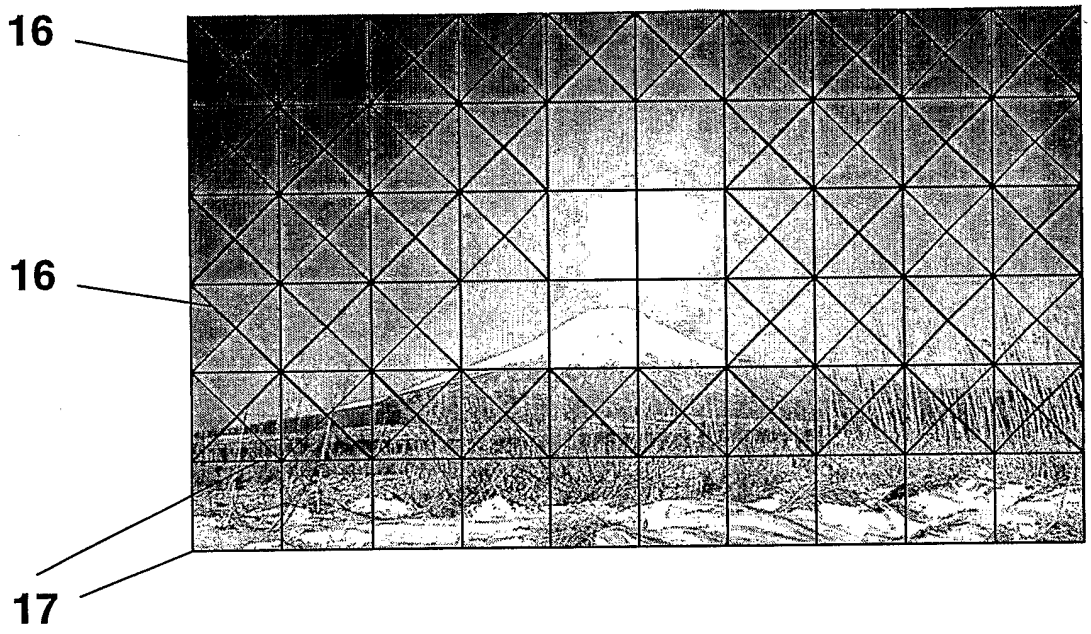

FIGURE 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ02/00116

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: G03B 7/091, H04N 5/235, G01J 1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI, ESPACE, USPTO: G03B, G01J, H04N and view, display, divide, partition, brightness, intensity, exposure, select, choose

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 11136568 A (Fuji Photo Film Co. Ltd.) 21 May 1999 See English abstract, English machine translation paragraphs 44-47, figures	1-6, 8-16, 18-21
X	JP 10186443 A (Canon KK) 14 July 1998 See English abstract, English translation of Japanese abstract, figures	1
X	EP 0570968 B1 (Matsushita Electric Industrial Co. Ltd.) 8 July 1998 See whole document	1

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 September 2002	26 SEP 2002
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **GREG POWELL** Telephone No : (02) 6283 2308

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ02/00116

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2256990 A (Samsung Electronics Co. Ltd.) 23 December 1992 See whole document	1-6, 8-12
X	US 4746947 (Masaaki Nakai) 24 May 1988 See whole document, including Description of the Prior Art section	1
X	US 4527881 (Saburo Sugawara) 9 July 1985 See abstract, columns 1 and 2, figures	13
X	JP 09026610 A (Nikon Corp.) 28 January 1997 See English abstract, paragraph 11 of English machine translation, figures	13
A	EP 0441117 A2 (Nikon Corporation) 14 August 1991 See abstract	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/NZ02/00116

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
JP	11136568	NONE					
JP	10186443	NONE					
EP	570968	US	5703644	JP	6046325		
GB	2256990	DE	4212515	JP	5167917		
US	4746947	JP	61194430	US	5006876	JP	61215537
US	4527881	DE	3426350	GB	2144231	JP	60031026
JP	9026610	NONE					
EP	441117	EP	647875	JP	3204628	US	5239333
		US	5495312				

END OF ANNEX