

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
8 January 2009 (08.01.2009)

PCT

(10) International Publication Number
WO 2009/005456 A1

(51) International Patent Classification:
H04N 5/33 (2006.01) *G06T 5/50* (2006.01)

(74) Agent: ALBIHNS AB; P.O. Box 5581, Linnégatan 2,
S-114 85 Stockholm (SE).

(21) International Application Number:
PCT/SE2008/050780

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(22) International Filing Date: 26 June 2008 (26.06.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/772,259 2 July 2007 (02.07.2007) US

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(71) Applicant (for all designated States except US): FLIR SYSTEMS AB [SE/SE]; P.O. Box 3, S-182 11 Danderyd (SE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): STRANDEMAR, Katrin [SE/SE]; Västergården 81 71, S-762 94 Rimbo (SE). INGERHED, Malin [SE/SE]; Malmvägen 16C, S-191 60 Sollentuna (SE).

Published:
— with international search report

(54) Title: CAMERA AND METHOD FOR USE WITH CAMERA

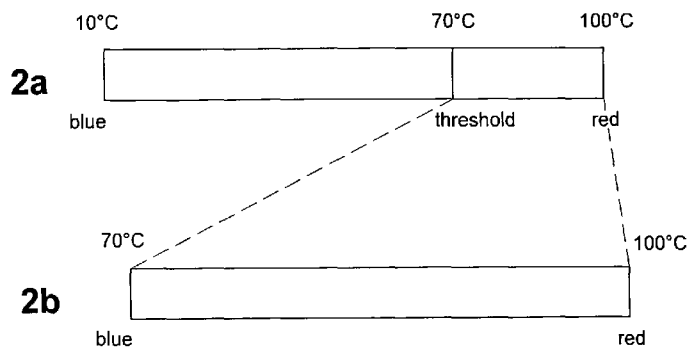


Fig. 2

(57) Abstract: A method of fusing IR image data and visible light image data corresponding to the same field of view in the same image is disclosed, comprising displaying IR image data in at least a first portion of the image and visible light image data in at least a second portion of the image. The method is characterized by the step of displaying the IR image data according to a colouring scheme adapted to the temperature range relevant for the first portion of the image. The resolution in the relevant temperature range is increased by applying the entire range of colours available in the colouring scheme to the selected temperature range.



WO 2009/005456 A1

CAMERA AND METHOD FOR USE WITH CAMERA

Technical Field

The present invention relates to a camera for producing IR images and visible light
5 images and images comprising a mix of IR and visible light data, and to a method for
use with such a camera.

Background and Related Art

In recent years methods and cameras have been proposed for combining IR images
10 and visible light images in various ways, often referred to as image fusion. Typically, a
camera will have an imaging part for capturing IR image data, another imaging part
for capturing visible light image data and means for processing the image data in such
a way that they can be displayed in the same image. Such functions may be helpful, for
example, in identifying the position of a hot, or cold, object.

15

Typically, the field of view of the visible light image is greater than the field of view
of the IR image. In any case the fields of view will differ, since the optical systems
capturing the two images will not be placed in exactly the same position. This is a well
known optical phenomenon called parallax. Hence, before displaying a fused, or
20 blended, image the two images must be aligned.

EP patent 1 299 699 discloses a method of displaying visible light image data and IR
image data in the same image, and a camera comprising imaging means both for IR
radiation and visible light. The data can be combined in a number of different ways,
25 for example, in dependence of the temperature of each respective pixel.

This patent also mentions the need for correcting the parallax caused by the image
capturing means for IR and visible light, respectively, being placed at a certain
distance from each other. Two main methods of parallax correction are suggested: by
optical means such as mirrors or by electronic means. How to correct the parallax by
30 electronic means is not discussed in detail.

International patent application WO2006/060746 discloses parallax correction based on the distance to the object. The distance to the object is in turn determined by the focusing distance. The method suggested in WO 2006/060746 is to use a magnet mounted on the IR lens and a Hall sensor mounted in the optics housing, or vice versa, whereby the Hall sensor will measure the distance to the magnet and hence the focusing distance. The actual focusing of the camera is performed manually, in a way known per se, by turning a focus ring. As an alternative it is suggested to align the images by manually displacing one relative the other until they overlap correctly.

A number of ways of combining the IR and visible light image data are proposed in WO 2006/060746. For example, the visible image may be shown in a grey scale and the IR image superimposed on this image in colour. Alternatively, the visible light image may be displayed, but for pixels in which the temperature values exceed a certain threshold value the visible light pixels may be replaced by IR image pixels.

It is an object of the present invention to improve the presentation of the combined IR and visible light image.

Summary of the Invention

This object is achieved according to the invention by a method of fusing IR image data and visible light image data corresponding to the same field of view in the same image comprising displaying IR image data in at least a first portion of the image and visible light image data in at least a second portion of the image, said method being characterized by the step of displaying the IR image data according to a colouring scheme adapted to the temperature range relevant for the first portion of the image.

The object is also achieved by a camera comprising a first imaging part for capturing IR image data of a first field of view, a second imaging part for capturing visible light data of a second field of view at least partially overlapping the first field of view, processing means for adjusting the first and second field of view relative to each other in dependence of the focusing distance of the first or second imaging part, and

processing means for selecting at least a first portion of the image in which IR image data is to be displayed and at least a second portion of the image in which visible light image data is to be displayed, said camera being characterized in that said processing means is arranged to apply a colouring scheme for IR data adapted to the temperature range relevant for the at least first portion of the image.

Hence, according to the invention the resolution in the relevant temperature range is increased by applying the entire range of colours available in the colouring scheme to the selected temperature range. Temperatures that are so close to each other that they would have essentially the same colour if the normal colouring scheme were used, may, with the method according to the invention, have different colours that can easily be distinguished.

For example, in a colour scheme ranging from blue for low temperatures to red for hot temperatures, all temperatures in the middle of the range may be represented as different nuances of yellow. All temperatures in the upper part of the range will be different nuances of red, and all temperatures in the lower part of the range will be different nuances of blue. Hence, temperatures that are close to each other are generally difficult to distinguish from each other. According to the invention, the whole range of colours may be applied to a part of the temperature interval. In this way, a range of temperatures that would be represented by similar nuances in the normal colouring scheme will be represented by a wider range of colours, for example, ranging from blue to red. For the parts of the image having a temperature outside of this interval visual light image data will be displayed.

Preferably the camera further comprises user input means for receiving information about the at least first portion of the image, to enable the selection of the at least first portion of the image comprising an object, or part of an object, or interest.

Alternatively, or additionally the camera may further comprise user input means for selecting the relevant temperature range. This will enable the selection of the at least first portion of the image as at least a first portion of the image having a temperature

within a selected temperature range.

Brief Description of the Drawings

The invention will be discussed in more detail in the following, by way of example
5 and with reference to the appended drawings, in which:

Fig. 1 illustrates a camera that may be used according to the invention

Fig. 2 illustrates an example of the change of temperature range according to an
embodiment of the invention

10 Detailed Description of Embodiments

Figure 1 illustrates schematically a camera 1 having a first imaging part 3 for capturing
IR images and a second imaging part 5 for capturing visible light images. The first
imaging part 3 comprises IR optics 7 that focuses incoming IR radiation onto an array
15 9 of IR sensing elements in a way known per se. Preferably the IR optics part
comprises one or more IR lenses 10, one of which may be driven by a motor 11 for
automatic and/or manual focusing. The second imaging part comprises visible light
optics 13 for focusing the incoming visible light onto an array 15 of visible light
sensing elements in a way known per se. The data registered by the array 9 are
20 forwarded to a processing unit 17 that processes the data to produce a suitable image,
which may be a visible light image, an IR image or a blended or fused image of IR and
visible light images. The camera also preferably comprises at least one display means
19 for displaying images and at least one memory unit 21 for storing registered image
data and/or processed images.

25

The camera is preferably also provided with a laser pointer 23, known per se, which
may be used to point out objects in the image.

According to the invention a new way of fusing the IR and visible light data is
30 proposed, in the case when visible light image data are displayed in part of the image
and IR data are displayed in another part. When selecting an area of the image for

which IR data is to be displayed, the temperature range for the IR image is restricted to the temperature range that is relevant for this area. This temperature range may be selected. Alternatively, a temperature range of interest may be selected directly. The colouring scheme of the IR image can then be adapted to the selected temperature
5 range, to improve the resolution in the IR image.

Hence, according to the invention, an area of the image, or a temperature range can be selected. Pixels in the selected area, or pixels having a temperature within the temperature range, will be shown as IR data. The remaining pixels will be shown as
10 visible light image data. For example, if the temperature in the whole image ranges from 15 degrees Celsius to 30 degrees Celsius, in the prior art, the colouring scheme would be adapted to this temperature range, even if the only IR data displayed would be in a part of this temperature range, for example 25-30 degrees Celsius. Therefore, the interesting temperature range of 25-30 would only use the upper part of the
15 colouring scheme, making it hard to distinguish between the colours in this area.

According to the invention, in this case the colouring scheme would be adapted to show 25 degrees as the coldest temperature and 30 degrees as the warmest temperature. In this way, the resolution would be increased, so that it would be easier
20 to distinguish between temperatures within the temperature range of interest.

Hence, according to the invention, the colouring scheme of the IR data is adapted to the temperature range of the part of the image selected to be displayed as IR image data.
25

The selected temperature range, for which IR data should be displayed, may be selected as an absolute range, for example from 20 to 30 degrees. It may also be a number of degrees at either end of the total temperature range of the image, for example a number of degrees below the maximum, or above the minimum degree of
30 the total temperature range. It may also be selected as a relative range, for example a certain fraction of the temperature range, such as the upper, or lower, 10 %, or 50 % of

the total temperature range. For example, if the total temperature range is 0 - 100 degrees Celsius the upper 10% would mean that temperatures between 90 and 100 degrees Celsius would be displayed as IR image data in the fused image, and that the whole colouring scheme would be applied in the temperature range between 90 and
5 100 degrees.

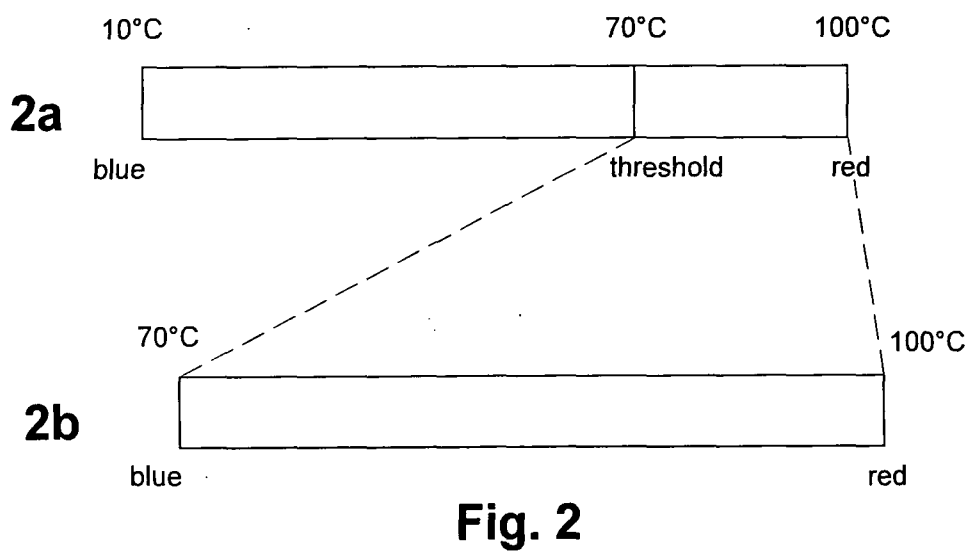
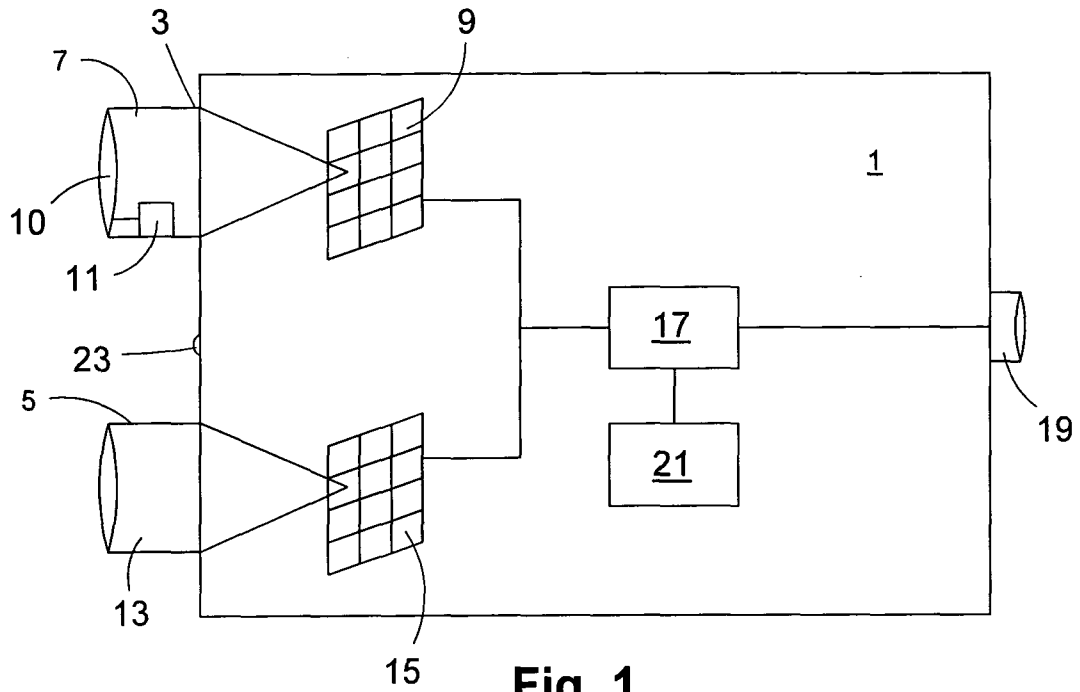
Figure 2 illustrates, as an example, a first temperature range 2a from 10°C to 100 °C, which is the temperature range of the whole field of view covered by the IR imaging part. A colouring scheme ranging from blue for the lowest temperatures to red for the
10 highest temperatures is used. A threshold is set, in this example, at 70°C. The pixels between 70°C and 100°C will be displayed as IR data in the fused image. According to the prior art, each IR pixel would keep the same colour as in the colouring scheme shown in 2a when fused into the fused image. Hence, all the pixels representing
15 temperature data in the fused image would probably be some shade of red. According to the invention, on the other hand, the colouring scheme is changed so that the entire range of colours is used for the temperatures that will be presented as temperature data in the image. This means that the the pixels representing temperature data in the
20 blended image would range from blue colours at 70°C to red colours at 100°C. Hence, according to the invention the temperatures in the range actually displayed in the image can be distinguished more easily by an operator.

Instead of selecting a temperature interval at the upper end of the range, as shown in Figure 2, an interval at the lower end of the range, or in the middle of the range may be selected, for example 10°C to 15°C or 30°C to 32°C or any other suitable interval
25 depending on the area or object of interest.

Claims

1. A method of fusing IR image data and visible light image data corresponding to the same field of view in the same image comprising displaying IR image data in at least a first portion of the image and visible light image data in at least a second portion of the image, said method being characterized by the step of displaying the IR image data according to a colouring scheme adapted to the temperature range relevant for the first portion of the image.
2. A method according to claim 1, wherein the at least first portion of the image is selected as at least a first portion of the image having a temperature within a selected temperature range.
3. A method according to claim 1, wherein the at least first portion of the image is selected as at least a first portion of the image comprising an object, or part of an object, or interest.
4. A camera comprising a first imaging part for capturing IR image data of a first field of view, a second imaging part for capturing visible light data of a second field of view at least partially overlapping the first field of view, processing means for adjusting the first and second field of view relative to each other in dependence of the focusing distance of the first or second imaging part, and processing means for selecting at least a first portion of the image in which IR image data is to be displayed and at least a second portion of the image in which visible light image data is to be displayed, camera being **characterized** in that said processing means is arranged to apply a colouring scheme for IR data adapted to the temperature range relevant for the at least first portion of the image.
5. A camera according to claim 4, further comprising user input means for receiving information about the at least first portion of the image.

6. A camera according to claim 4, further comprising user input means for selecting the relevant temperature range.



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2008/050780

A. CLASSIFICATION OF SUBJECT MATTER		
IPC: see extra sheet 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)		
IPC: H04N, G06T		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE,DK,FI,NO classes as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPO-INTERNAL, WPI DATA, PAJ, INSPEC, COMPENDEX		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006060746 A2 (INFRARED SOLUTIONS, INC.), 8 June 2006 (08.06.2006), page 2, line 29 - page 3, line 4; page 4, line 26 - line 31; page 9, line 23 - line 26, p.15-li.11,p.16-li.20, p.14-li.17-li.27 --	1-6
A	US 5555324 A (A.M.WAXMAN ET AL), 10 Sept 1996 (10.09.1996), column 2, line 3 - line 34, abstract --	1-6
A	EP 1299699 B1 (FLIR SYSTEMS AB), 9 August 2006 (09.08.2006), see the whole document --	1-6
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"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</p> <p>"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</p> <p>"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</p> <p>"&" document member of the same patent family</p>		
Date of the actual completion of the international search		Date of mailing of the international search report
21 October 2008		22-10-2008
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86		Authorized officer Jesper Bergstrand / itw Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2008/050780

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0343634 A2 (FUJITSU LTD.), 29 November 1989 (29.11.1989), column 5, line 27 - line 44 -- -----	1-6

International patent classification (IPC)**H04N 5/33** (2006.01)**G06T 5/50** (2006.01)**Download your patent documents at www.prv.se**

The cited patent documents can be downloaded at www.prv.se by following the links:

- In English/Searches and advisory services/Cited documents (service in English) or
- e-tjänster/anförda dokument (service in Swedish).

Use the application number as username.

The password is **YVBJFPJGPM**.

Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/08/2008

International application No.

PCT/SE2008/050780

WO	2006060746	A2	08/06/2006	CN	101111748	A	23/01/2008
				EP	1831657	A	12/09/2007
				US	20060249679	A	09/11/2006
				US	20060289772	A	28/12/2006
				US	20080099678	A	01/05/2008

US	5555324	A	10/09/1996	WO	9613806	A	09/05/1996

EP	1299699	B1	09/08/2006	AU	7475401	A	24/12/2001
				DE	60122153	D,T	28/06/2007
				SE	523955	C	08/06/2004
				SE	0101363	A,L	20/10/2002
				AT	291406	T	15/04/2005
				AU	1566201	A	30/05/2001
				DE	60018976	D,T	23/03/2006
				DK	1244408	T	11/07/2005
				EP	1244408	A,B	02/10/2002
				SE	1244408	T3	
				MX	PA02003878	A	23/10/2002
				PL	355509	A	04/05/2004
				SE	522328	C	03/02/2004
				SE	0002258	A,L	17/12/2001
				SK	5022002	A	06/08/2002
				US	6908456	B	21/06/2005
				WO	0196824	A	20/12/2001

EP	0343634	A2	29/11/1989	JP	1296785	A	30/11/1989
				JP	2047874	U	03/04/1990
				US	4967276	A	30/10/1990
