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Datasheet for the decision of 18 July 2012

Case Number: T 1848/08 - 3.5.04

Application Number: 04252906.5

Publication Number: 1501288

IPC: H04N5/235

Language of the proceedings: EN

Title of invention:
CMOS image sensor using high frame rate with frame addition and movement compensation

Applicant:
OmniVision Technologies, Inc.

Headword:

Relevant legal provisions:
EPC 1973 Art. 54, 56
EPC Art. 123(2)

Keyword:
Inventive step - (yes)

Decisions cited:

Catchword:

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Case Number: T 1848/08 - 3.5.04

D E C I S I O N
of the Technical Board of Appeal 3.5.04
of 18 July 2012

Appellant: (Applicant)	OmniVision Technologies, Inc. 1341 Orleans Drive Sunnyvale, California 94089 (ETATS-UNIS D'AMERIQUE)
Representative:	Hackney, Nigel John Mewburn Ellis LLP 33 Gutter Lane London EC2V 8AS (ROYAUME UNI)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted 28 April 2008 refusing European patent application No. 04252906.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: F. Edlinger
Members: C. Kunzelmann
B. Müller

Summary of Facts and Submissions

I. The appeal is against the decision of the examining division to refuse European patent application No. 04 252 906.5 (published as EP 1 501 288 A2).

II. The decision to refuse was based on the ground that the subject-matter of claim 1 of all the requests then on file did not involve an inventive step within the meaning of Article 56 EPC 1973 having regard to the disclosure in documents

D1: US 5 657 402 A and
D2: US 2003/0098919 A1.

III. With the statement of grounds of appeal the appellant filed sets of claims according to a main request and auxiliary requests 1 to 11.

IV. The board issued a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA), annexed to a summons to oral proceedings.

V. By letter dated 3 May 2012 the appellant replaced all previous sets of claims with claims according to a new main request and a single auxiliary request, each comprising claims 1 to 3. The appellant also filed replacement description pages 1 to 8 for the main and the auxiliary request. The appellant asked the board to indicate if it considered any of the main or auxiliary requests to be allowable in substance, with a view to reaching an allowable set of claims without the need for oral proceedings.

VI. In a telephone conversation of 6 June 2012 the rapporteur informed the appellant that the oral proceedings could probably be cancelled if the main request were withdrawn.

VII. By letter of 7 June 2012 the appellant withdrew the main request conditional on cancellation of the oral proceedings scheduled for 27 June 2012. The auxiliary request dated 3 May 2012 was maintained as the sole request.

VIII. By communication dated 13 June 2012 the board informed the appellant that the oral proceedings were cancelled.

IX. Claim 1 of the sole request reads as follows:

"A method of forming a composite image (205) using a CMOS image sensor (401), the method comprising:
capturing a plurality of successive frames (201a-d) using said image sensor wherein each of said plurality of frames is captured using the same exposure time;
identifying a reference point (207) in each of said plurality of frames;
aligning said plurality of frames using said reference point; and
combining said plurality of frames into said composite image by simple arithmetic addition of said plurality of frames."

Claims 2 and 3 are dependent on claim 1.

X. The reasons given in the decision under appeal concerning claim 1 of the second auxiliary request then on file (which is the claim most closely resembling claim 1 of the present sole request) may be summarised as follows:

Document D2 was considered as the closest prior art. The subject-matter of claim 1 differed from the method of D2 in that:

- a reference point was identified in each of said plurality of frames;
- said plurality of frames was aligned using said reference point;
- each frame in the plurality of frames was captured over substantially the same exposure time; and
- the frames were combined by simple arithmetic addition.

The problem of motion blur had been recognised in D2 (paragraphs [0038] and [0039]). Faced with the problem of reducing motion blur, it would have been obvious to a person skilled in the art to identify a reference point in each of said plurality of frames and align said plurality of frames using said reference point as described in D1 (column 19, line 37 to column 20, line 12 and figure 14). It was also obvious to capture images to be combined using the same exposure time. This enabled the alignment and combination of the plurality of images without the need for complex image preprocessing such as brightness correction. The combination of frames by simple arithmetic addition was considered to be an obvious and straightforward solution for combining the images captured in fractions of the normal exposure time.

XI. The appellant's arguments may be summarised as follows:

Neither D1 nor D2 disclosed the features of

- forming a composite image in a method that included capturing a plurality of successive

frames wherein each of said plurality of frames was captured using the same exposure time, and

- combining a plurality of frames into a composite image by simple arithmetic addition of the plurality of frames.

These novel features solved the technical problem of providing, in an efficient manner, an image having good signal-to-noise ratio and dynamic range, without excessive blur caused by holding instability of the user. Paragraphs [0016], [0037] and [0038] of D2 referred to methods in which shorter exposure time images captured the brighter areas of a scene while longer exposure time images captured the darker areas of the scene. Thus D2 taught a method in which a plurality of images were captured using different exposure times. D2 and the prior-art method mentioned therein necessitated a more complex method of combining which involved, on a pixel-by-pixel basis, appropriately scaling each pixel's last sample before saturation to synthesize a final image.

D1 was concerned with a different problem, namely that of generating a higher resolution still image from a plurality of images in a video sequence.

Reasons for the Decision

1. Amendments (Article 123(2) EPC)

1.1 Claim 1 is essentially the combination of claims 1 to 3 as filed and as disclosed on page 7, lines 6 to 8 and lines 13 to 15, as filed. The feature that the captured frames are successive frames is disclosed on page 6, lines 4 and 5, as filed.

1.2 The subject-matter of claims 2 and 3 is disclosed in claims 4 and 5 as filed.

1.3 The description has been amended by deleting alternatives no longer claimed and by acknowledging documents D1 and D2.

1.4 Hence the application has not been amended in such a way that it contains subject-matter which extends beyond the content of the application as filed.

2. Novelty (Article 54(1) and (2) EPC 1973)

Document D1, at least, does not disclose using a CMOS image sensor to capture frames, and relates to a different problem, namely that of generating a higher resolution still image from a plurality of images in a video sequence (see column 3, lines 1 to 23). Also D2, as set out below, does not disclose the method of present claim 1. Thus the method of present claim 1 does not form part of the available state of the art.

3. Inventive step (Article 56 EPC 1973)

3.1 The appellant does not dispute the position of the examining division that D2 is the closest prior art, and the board agrees because it comes closer than D1 to the objective of the present invention.

D2 discloses a method of forming a composite image using a CMOS image sensor (see, for instance, the title, claim 1, and paragraphs [0004], [0016], [0037], [0056] and [0160]). The method comprises capturing a plurality of successive frames (see figure 4 and paragraphs [0058] to [0065]) using said image sensor.

It also comprises combining said plurality of frames into said composite image (see figure 10 and paragraph [0155]).

3.2 The method of present claim 1 differs from the one known from D2 in the following features:

(i) each of said plurality of frames is captured using the same exposure time;
(ii) a reference point is identified in each of said plurality of frames;
(iii) said plurality of frames is aligned using said reference point;
(iv) the plurality of frames is combined into said composite image by simple arithmetic addition of said plurality of frames.

3.3 Features (i) to (iv), in combination, contribute to providing, in an efficient manner, an image having good signal-to-noise ratio and dynamic range, without excessive blurring caused by movement of the image sensor or the photographed scene (see page 1, line 21 to page 2, line 10; page 5, line 16 to page 6, line 16; and page 8, lines 15 to 17, of the description).

3.4 Also D2 is concerned with the problem of blur (see figure 10 and paragraphs [0057] and [0155]). In particular, D2 discloses algorithms which aim at avoiding unacceptable blur due to motion or change of illumination (see paragraph [0017]). The algorithms disclosed in D2 operate on each pixel separately (see paragraph [0131]) and output, for each pixel, a photocurrent estimate determined on the basis of a number of pixel readings taken at different exposure times $0, \tau, 2\tau, 3\tau, \ldots, n\tau=T$, T being the normal exposure time (see figure 4, paragraphs [0058]

to [0065], and [0159] to [0161]). Thus ideally all the readings of the given pixel are used for the photocurrent estimation of the given pixel. But due to motion and/or saturation the estimation may not use all these readings (see paragraph [0077]). Therefore, the algorithms disclosed in D2 employ all the readings of a given pixel before it reaches saturation (see paragraph [0057]) but do not employ the readings of a pixel for which motion is determined to have occurred (see paragraphs [0064] and [0142]). The algorithms are such that storage requirements are small and independent of the number of images captured (see paragraph [0161]).

3.5 According to the teaching of D2 the occurrence of blur in the composite image caused by movement of the image sensor or the photographed scene is avoided. Hence there is no need for generally known image registration techniques to correct blur in the composite image. In particular there is no need for the image registration technique disclosed in D1. Moreover, the image registration technique disclosed in D1 is carried out on frames stored in computer memory (see D1, column 5, lines 33 to column 6, line 10; column 7, lines 19 to 29, and column 18, lines 17 to 48). This is contrary to the teaching of D2, according to which the storing (in a memory) of a complete frame for every captured image is avoided (see paragraph [0161]). Hence a person skilled in the art would not have used the image registration technique disclosed in D1 in combination with the image forming method of D2.

3.6 Features (i) and (iv) (see point 3.2 above) make the method of claim 1 more efficient (see page 2, lines 14 to 18 and page 7, lines 6 to 14, of the description).

3.7 Indeed, the algorithms of D2 are computationally more intensive than the simple arithmetic addition of frames specified in claim 1 of the present application.

3.8 Also the prior art discussed in D2 (paragraphs [0038] and [0039]) uses multiple image captures wherein different images have different exposure times. In this respect the appellant's argument that the "prior implementations" referred to in paragraphs [0038] and [0039] are those discussed in paragraph [0016] of D2 convinced the board. The reason is that the prior art discussed in paragraphs [0016] and [0017] of D2 is the only one making use of multiple image captures. The composite image "is then synthesized from the multiple captures by appropriately scaling each pixel's last sample before saturation" (see paragraphs [0016] and [0017]).

3.9 In view of the above the board finds that the method of claim 1 according to the present sole request was not obvious to a person skilled in the art in view of documents D1 and D2.

3.10 The board does not see any other reason why the method of claim 1 would have been obvious to a person skilled in the art.

3.11 Hence the board judges that the method of claim 1 according to the present sole request involves an inventive step (Article 56 EPC 1973).

4. Thus the decision under appeal is to be set aside.

5. The board does not see any other reason which would prejudice the grant of a patent.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent in the following version:
   Description:
   Pages 1 to 8 filed with the letter of 3 May 2012.
   Claims:
   Nos. 1 to 3 filed with the letter of 3 May 2012 and labelled "Auxiliary Request 1" therein.
   Drawings:
   Sheets 1/4 to 4/4 as originally filed.

The Registrar: The Chairman:

K. Boelicke F. Edlinger

Decision electronically authenticated