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**Datasheet for the decision
of 9 December 2015**

Case Number: T 2119/10 - 3.4.02

Application Number: 05779385.3

Publication Number: 1794557

IPC: G01J5/22, H04N5/33, H04N5/217

Language of the proceedings: EN

Title of invention:

METHOD AND SYSTEM FOR INCREASING SIGNAL-TO-NOISE RATIO IN
MICROBOLOMETER ARRAYS

Applicant:

Opgal Optronik Industries Ltd.

Headword:

Relevant legal provisions:

EPC 1973 Art. 56

Keyword:

Inventive step - (yes)

Decisions cited:

Catchword:



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Case Number: T 2119/10 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 9 December 2015

Appellant: Opgal Optronik Industries Ltd.
(Applicant) Industrial Area 5
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Representative: Petraz, Gilberto Luigi
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 22 April 2010
refusing European patent application No.
05779385.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman B. Müller
Members: F. Maaswinkel
H. von Gronau

Summary of Facts and Submissions

I. The appellant lodged an appeal against the decision of the examining division refusing the European patent application number 05779385.3. This patent application relates to a retrieval module for a temperature sensor array and to a method of acquiring a thermal image using a retrieval module.

According to the decision, the subject-matter of claims 1 and 7 then on file did not involve an inventive step within the meaning of Article 56 EPC having regard to the combined disclosures in documents D1 (considered as being the closest prior art) and D2:

D1: US 5 698 852 A

D2: US 6 697 108 B1.

II. With the letter containing the grounds of appeal the appellant requested to set aside the decision and to grant a patent on the basis of claims 1 to 7 filed with this letter. The appellant also filed an auxiliary request for oral proceedings.

III. In a communication pursuant to Rule 100(2) EPC the board raised objections under Article 84 EPC 1973.

IV. With a letter received on 21 May 2015 the appellant filed revised description pages 10 and 11. With a further letter received on 16 November 2015 the appellant filed an amended set of claims 1 to 7 and requested that a patent be granted on the basis of these claims.

V. This request comprises the following documents:

Claims: 1 to 7, filed on 16 November 2015;
Description: pages 1 to 9, and 12 to 17 of the
published patent application;
pages 10 and 11 filed with the letter of
21 May 2015;
Drawings: sheets 1/7 to 7/7, of the published
patent application.

VI. The wording of independent claim 1 is as follows:

" A device, for retrieving electrical charge, resulting from electromagnetic radiation energy incident on a temperature sensor array of N rows and M columns, said temperature sensor array including a plurality of N temperature sensor rows, each temperature sensor row including a plurality of M temperature sensors, the device comprising:

a retrieval module array including a plurality of K retrieval module rows, each retrieval module row including a plurality of M retrieval modules, each said retrieval modules being operative to accumulate said electrical charge, from a single temperature sensor;
and

a row select circuit, coupled with said temperature sensor array and with said retrieval module array, for coupling said M retrieval modules of each said retrieval module row of said retrieval module array with a respective temperature sensor of an allocated temperature sensor row of said temperature sensor array, for a time period which is greater than the frame acquisition period divided by the number of said temperature sensor rows ".

The wording of independent claim 4 is as follows:

" A method for acquiring a thermal image, the thermal image being associated with electrical charge, the electrical charge resulting from electromagnetic radiation energy incident on a temperature sensor array of N rows and M columns, the temperature sensor array including a plurality of N temperature sensor rows, each temperature sensor row including a plurality of M temperature sensors, the method comprising the procedures of:

selecting a temperature sensor row from said temperature sensor array;

from a retrieval module array, said retrieval module array including a plurality of K retrieval module rows, allocating a retrieval module row, wherein each said retrieval module row includes a plurality of M retrieval modules;

coupling each said temperature sensor from said selected temperature sensor row with a respective retrieval module from said allocated retrieval module row, for a time period which is greater than the frame acquisition period divided by the number of said temperature sensor rows;

retrieving said electrical charge of each of said temperature sensors by the respective said retrieval modules coupled therewith; and

repeating from said procedure of selecting, for another of said temperature sensor row and another retrieval module row, before said time period elapses, with respect to said selected temperature sensor row and said allocated retrieval module row ".

Claims 2, 3 and claims 5 to 7 are dependent claims.

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

In the decision under appeal document D1 was regarded as being the closest prior art. According to section 6.2 of the decision, the device of claim 1 differed from the disclosure in D1 in that:

- it comprises a retrieval module array which includes a plurality of retrieval module rows; and
- the integration period of each temperature sensor is greater than the frame acquisition period divided by the number of said temperature sensor rows.

According to section 6.3 of the decision, the problem to be solved could be regarded as "how to increase the signal-to-noise ratio of a microbolometer array sensor system". It was asserted that "D1 already suggests the parallel reading of pixels by multiple integration circuits in order to increase the integration period of each one of them". Subsequently document D2 was referred to since this document "attempts to solve the same problem in a CMOS imaging sensor, by performing correlated double sampling on the pixel readout data". It was further argued that, in order to further increase the integration time, D2 suggests the implementation of two or even four column blocks for the column readout circuitry as well as the readout of a complete row of pixels at one time in a parallel fashion. In applying the latter configuration, it could be easily demonstrated that the integration period of each pixel is greater than the frame acquisition period divided by the number of the temperature sensor rows. In section 6.6 it was stated that it would be "obvious for the person skilled in the art to attempt to further increase the integration period of each microbolometer pixel of D1 by applying the teachings of D2 to the microbolometer array sensor of D1".

With respect to D2, this document describes a photosensitive sensor array for fast frame readout for the sensor array with an on-chip integrated SCDS (Sequential Correlated Double Sampling). In Correlated Double Sampling (CDS) every pixel sensor is sampled twice, in order to correct Fixed Pattern Noise (FPN), which results from non-uniformities and mismatches between the sensors, caused during the fabrication process. The first sample is that of background noise and FPN, and the second sample is that of background noise, FPN and data signal. Subtracting the two samples removes the noise common to both samples (i.e., the FPN). It is noted that Correlated Double Sampling can remove only Fixed Pattern Noise, and FPN cannot be reduced by increasing the integration period. On the other hand, random noise cannot be reduced by subtraction without removing the data signal. Document D2 describes that, after the integration period, the photodiode of each pixel in a single row is coupled with the respective column readout circuitry, which performs CDS. The column block is a single unit operative to sample a single pixel at any given moment. Such a column block is neither designed, nor operative, to sample more than a single pixel (e.g., an entire column or part thereof) simultaneously. In D2 the integration is performed by the photodiode (i.e., not by the column block), which removes charge from the IN input node (see col. 6, 1.35 - 63) and the integration period occurs before the column block is connected with the photodiode.

Finally, concerning increasing the integration period: D2 neither describes, nor suggests, any problem or solution related to an integration period in general and to increasing thereof in particular. As mentioned above, a column block according to D2, is not directed at

integration, in general, and at integration of microbolometers in particular. The column block of D2 samples information, which was already integrated at the sampled pixel. Contrary to the assertion in the decision, the use of two or four column blocks will not increase the integration time, since the integration time is not performed by the column blocks.

With respect to the argument of applying the teachings of D2 to the microbolometer array of D1: a priori, each of documents D1 and D2 commences from single pixel readout module and expands to more than one in a single row (D1), up to an entire row (D2). Neither leaps beyond a single dimension to the innovative two-dimensional approach of the claimed invention. Accordingly, applying D2 to D1 will, at most, increase the number of readout units up to the number of pixels in a single row. In any configuration provided by either D1, D2 or a combination thereof, the maximum number of pixels which are sampled/integrated at any given moment does not exceed beyond that of a single row, and is limited to a single row.

In any case, applying the teaching of D2 to the microbolometer array of D1 results in two column blocks described in D2 performing CDS on the output of the two read-out and integration circuits (ROICs) 6 and 6' in Figure 7 of D1. Hence, it should be clear that D2 does not disclose the features of current claim 1 of the present application that are not disclosed in D1, and therefore it cannot support the deficiencies of D1 in claiming a lack of inventive step of such a claim 1. Claim 1 and also method independent claim 4 are therefore novel and inventive over the combination of the prior art documents D1 and D2.

Reasons for the Decision

1. The appeal is admissible.

2. Amendments

The claims of the present request substantially correspond to claims 1 to 3 and claims 7 to 10 of the patent application as originally filed, with some clarifications in claims 1 and 4 to define the structure of the array and the retrieval module. These features are disclosed in Figure 4 and the corresponding original description at pages 13 - 15. Pages 10 and 11 of the description have been amended to bring the summary of invention in conformity with the amended claims. Therefore, the application documents comply with the provisions of Article 123(2) EPC.

3. Patentability

3.1 Novelty

3.1.1 During the examination proceedings, the novelty of the subject-matter of the independent claims had not been questioned.

3.2 Inventive step

3.2.1 In the decision under appeal document D1 had been considered as the closest prior art.

3.2.2 This document discloses a device for retrieving electrical charge resulting from electromagnetic radiation energy incident on a temperature sensor array

of N rows and M columns (two-dimensional bolometer with pixels P_{ij} , see Fig.3 and Fig.7). In the embodiment of Fig.7 the device comprises a retrieval module array including one retrieval module row including a plurality (in Fig.7: two; according to col.14, 1.33 "three or more output terminals can be provided") of retrieval modules (6,6'), each retrieval module being operative to accumulate the electrical charge from a single temperature sensor; and a row select circuit (1,2), coupled with said temperature sensor array and with said retrieval module array, for coupling the retrieval modules of the retrieval module row of the retrieval module array with respective temperature sensors (P_{ij}) of an allocated temperature sensor row of the temperature sensor array.

3.2.3 The device defined in claim 1 differs from the arrangement in document D1 in that its retrieval module array (KxM array 106 in Fig. 4 of the published patent application) includes a plurality (K) of retrieval rows of which each retrieval module row includes a plurality of M retrieval modules, i.e. corresponding to the M temperature sensors of each row of the sensor array (NxM array 102); and in that its select circuit is a row select circuit (108) coupling the M retrieval modules of each retrieval module row of the retrieval module array with a respective temperature sensor of an allocated temperature sensor row of the temperature sensor array, for a time period which is greater than the frame acquisition period divided by the number of the temperature sensor rows.

3.2.4 In this respect the board does not concur with the position of the examining division that document D1 discloses the closest prior art: indeed, as put forward by the appellant in the grounds of appeal with respect

to D1, this document commences from a single pixel readout module and expands to more than one module in a single row. However, although D1 (see col. 14, l. 31 - 41) discloses that "three or more output terminals can be provided" there appears to be no disclosure in this document that the device could comprise a number of readout modules in a "row" equal to the number of pixel elements in the rows of the Focal Plane Array (FPA). Rather, the closest prior art could be identified in document US-A-6 028 309 (in the following: D3), in particular Figure 14, which shows an FPA with a ROIC similar as in Figure 2 of the patent application, which comprises a row (76, in Figure 2) of M ROIC modules enabling to read out and integrate one complete row of M microbolometer pixels at the same time. Document D3 is acknowledged at page 9, l. 1 - 4 of the published patent application.

3.2.5 The device defined in claim 1 differs from the arrangement in document D3 in that its retrieval module array includes a plurality (K) of retrieval rows; and that its row select circuit couples the M retrieval modules of each of the K retrieval module rows of the retrieval module array with a respective temperature sensor of an allocated temperature sensor row of the temperature sensor array, for a time period which is greater than the frame acquisition period divided by the number of the temperature sensor rows.

3.2.6 The technical problem solved by these features is to increase the signal-to-noise ratio by increasing the integration time, because K of the N rows of the NxM bolometer array can simultaneously be integrated and read out.

- 3.2.7 In the decision under appeal the examining division argued that the problem of how to increase the signal-to-noise ratio of a microbolometer array sensor system and its solution, namely to increase the integration period of each microbolometer pixel while maintaining the frame acquisition period stable, was known from documents D1 and D2.
- 3.2.8 With respect to document D1 the board concurs with this statement, although, as set out in point 3.2.4 supra, the arrangement in Figure 14 of document D3 appears to be closer to the claimed device.
- 3.2.9 However, document D2 is not concerned with the read-out of bolometer arrays but with a CMOS imaging array in which the integration takes place at the photosensitive surface, and not during the read out of the (passive) bolometer pixels. As disclosed in this document, one of the main problems in such CMOS arrays is fixed pattern noise (FPN) caused by the separate drive circuitry of the columns (D2, col. 1, l. 60 - 64). The way to avoid this is by correlated double sampling (CDS) which slows down the read out rate (col. 2, l. 8 - 15). Therefore, the solution of reading out one row of pixels at a time is not motivated by the wish of increasing the signal-to-noise ratio by (individual) longer read-out (and integration), but to increase the system speed (and still profiting of CDS) which is relevant for achieving video rates, see D2, col.2, l. 13-15.
- 3.2.10 It is concluded that document D2 is not directed to optimising/maximising the integration and read-out time of passive bolometer pixels and that the skilled person, wishing to improve the signal-to-noise performance of a bolometer array (such as the one in document D1; or in

document D3), would not have found an incentive to combine the teaching of document D2 with the prior art.

- 3.3 It is concluded that the subject-matter of claim 1 is novel and involves an inventive step.
- 3.4 Claim 4 defines a method for acquiring a thermal image using a temperature sensor array and employing a retrieval module array with the structure as defined in claim 1. Therefore, the subject-matter of this claim is patentable for the reasons as discussed supra.
4. Claims 2, 3 and claims 5 to 7 are dependent claims and are equally allowable.
5. For the above reasons, the board finds that the appellant's request meets the requirements of the EPC and that a patent can be granted on the basis thereof.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent based on the following documents:

Claims: Nos 1 to 7, filed on 16 November 2015;
Description:

pages 1 to 9, and 12 to 17 of the
published patent application
pages 10 and 11 filed with the letter of
21 May 2015;

Drawings:

sheets 1/7 to 7/7, of the published
patent application.

The Registrar:

The Chairman:



M. Kiehl

B. Müller

Decision electronically authenticated



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Case Number: T 2119/10 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of correcting an error in the decision
of 9 December 2015

Appellant: Opgal Optronik Industries Ltd.
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Representative: Petraz, Gilberto Luigi
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted on 22 April 2010 refusing European patent application No. 05779385.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman B. Müller
Members: F. Maaswinkel
H. von Gronau

In application of Rule 140 EPC 2000 the decision of 9 December 2015 is corrected as follows:

In point 2 of the **Order**, the documents specifying the description documents

" pages 1 to 9, and 12 to 17 of the published patent application pages 10 and 11 filed with the letter of 21 May 2015; "

should be corrected as

" pages 1 to 15 filed with the letter of 4 February 2016; ".

The description pages 1 to 15 filed with the letter dated 4 February 2016 are a fair copy of the description pages 1 to 15 filed on 7 March 2007 including the amended summary of the invention filed with the letter dated 21 May 2015.

The Registrar:

The Chairman



M. Kiehl

B. Müller

Decision electronically authenticated