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Datasheet for the decision of 15 February 2008

Case Number: T 0755/04 - 3.5.01

Application Number: 95112962.6

Publication Number: 0697642

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Language of the proceedings: EN

Title of invention:
Optical operation apparatus

Applicant:
FUJIFILM Corporation

Opponent:
-

Headword:
Optical inner product/FUJIFILM

Relevant legal provisions:
-

Relevant legal provisions (EPC 1973):
EPC Art. 56

Keyword:
"Inventive step - (yes) after amendment"

Decisions cited:
-

Catchword:
-

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Case Number: T 0755/04 - 3.5.01

D E C I S I O N
of the Technical Board of Appeal 3.5.01
of 15 February 2008

Appellant: FUJIFILM Corporation
26-30, Nishiazabu 2-chome
Minato-ku
Tokyo (JP)

Representative: Klunker . Schmitt-Nilson . Hirsch
Winzererstrasse 106
D-80797 München (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 5 February 2004 refusing European application No. 95112962.6 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: S. Steinbrener
Members: W. Chandler
A. Pignatelli

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division to refuse the application on the grounds that the subject-matter of claim 1 of the main request was not new (Article 54(1) EPC 1973) and of claim 1 of the auxiliary request did not involve an inventive step (Article 56 EPC 1973). The following documents were mentioned in the decision:

D1: ZHANG W. et al.: "Optoelectronic Implementation of Bipolar Analog Neural Network Using Shadow Casting", Japanese Journal Of Applied Physics, vol. 29, no. 7, 1990, TOKYO JP, pages L1325 - L1327

D2: TURNER R.M. et al.: "CMOS Photodetectors for Correlation Peak Location", IEEE Photonics Technology Letters, vol. 6, no. 4, 1994, NEW YORK US, pages 552 - 554

II. The appellant requested that the decision under appeal be set aside and that a patent be granted on the documents on file. The appellant also made an auxiliary request for oral proceedings.

III. In the communication accompanying the summons to oral proceedings, the Board summarised the issues to be discussed and tended to agree with the examining division that the subject-matter of claim 1 of the main request was not new.

IV. At the oral proceedings before the Board, the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the single claim submitted at the oral proceedings. At the end of

the oral proceedings, the Chairman announced the decision.

V. The single claim reads as follows:

"An optical computing apparatus for carrying out an operation for finding an inner product of a first vector and a second vector by utilizing light, the optical computing apparatus comprising:

i) an optical vector encoding means for forming an encoded optical distribution, which is based on all of the elements of the first and second vectors, and in which the intensities have been encoded in accordance with the values of the elements of the first vector, and the centers of gravity of local intensities have been position encoded in accordance with the values of the elements of the second vector, and

ii) a product sum decoding means for extracting a value of an inner product of the first vector and the second vector in accordance with said encoded optical distribution, which has been formed by said optical vector encoding means, and feeding out the information representing said inner product value, wherein said product sum decoding means comprises a position sensitive light detector exposed to said encoded optical distribution and having a pair of output electrodes, and an electric operation means which calculates said inner product value from the difference between the output currents delivered by said output electrodes of the position sensitive light detector."

VI. The appellant argued essentially as follows:

Dl disclosed using a plurality of photodiodes to detect the amplitude of the light at certain positions, but not a position sensitive light detector (PSD).

It was true that the positions of the received light spots were important in Dl. However, it was not true that a skilled person would "carry out experiments with the Dl device and with known PSDs in order to achieve a 'real' position detection of the received light" as stated in the second paragraph of page 5 of the decision in connection with the auxiliary request.

Although a PSD itself was well-known, the way of using the PSD was quite novel and non-obvious in the present invention. Conventionally, the PSD had been used to determine a position of a centre of mass. For that purpose, the PSD was usually connected to an operation circuit which calculated the value of (IA—IB)/(IA+IB) from output currents IA and IB of the PSD. The specification of the present application clearly explained it as the conventional use of the PSD. Also, D2 described this conventional use. On the other hand, in the present invention the PSD was used together with the electric operation means which calculated the value of IA-IB or a multiple value thereof. This enabled the PSD, which had conventionally been used to determine a position of a centre of mass, to be used to determine an inner product of two vectors.

Reasons for the Decision

1. The application concerns an optical computing apparatus for performing a vector-matrix inner product. It achieves this by forming a pattern of light in which the intensities represent the elements of the first multiplicand and the positions of the centres of gravity of the intensities represent elements of the second multiplicand (see e.g. Figures 5 and 6 and associated text). A position sensitive light detector PSD receives the light distribution and the output signal is processed to produce the product of the multiplicands (for the principle, see page 7, line 38 to page 8, line 41).

2. D1 is the closest prior art and it discloses an optoelectronic arrangement for performing a matrix inner product multiplication in a bipolar analog neural network using an optical shadow casting technique. The intensities of a complementary pair of LEDs represent an element of the first multiplicand. The position of an open area of a weight mask represents an element of the second multiplicand (see Figure 1). In so far, D1 discloses the encoded light distribution of feature i) of the claim.

3. D1 also discloses by definition a product sum decoding means according to the first part of feature ii). However D1 does not disclose that this means comprises a position sensitive light detector (PSD).

4. By introducing this feature into the claim, the appellant has overcome the ground of lack of novelty

against claim 1 of the main request before the examining division.

5. The subject-matter of the claim therefore essentially differs from D1 in that the light distribution is decoded using a PSD instead of using a decoding mask and a photodiode for each product term. The Board considers that this solves the problem of providing an alternative method of decoding the light distribution to form the vector product.

6. The Board does not consider that the skilled person starting from D1 would use a PSD to solve this problem. As its name suggests, a PSD (position sensitive detector) is known to detect the position of light incident on it. D2 discloses using a PSD instead of a photodiode array to improve the accuracy of peak detection in an optical correlator where a "small number of well-spaced bright points occur" (see Introduction, lines 1 to 29). Thus, the skilled person might well consult D2 in order to try to solve a problem connected with detecting peaks. However, D1 uses an arrangement involving a weighting mask, a decoding mask with *fixed* openings and an fixed array of photodiodes correlated with said openings. Thus, although the positions of the openings are obviously important in D1, the positions where light is to be detected are fixed and there is thus no requirement to detect positions of peaks; all that is necessary is to detect the intensity of the light at the number of fixed openings of the decoding mask. Thus, in the Board's view the skilled person would have no incentive to use a PSD in the arrangement of D1.

7. The examining division essentially argued that as the positions of the received light spot in D1 were important, the skilled person would "carry out experiments with the D1 device and with known PSDs in order to achieve a 'real' position detection of the received light" without specifying what these would be or what they would achieve. The Board considers that this argumentation is too simplistic. Apart from the lack of incentive to use the PSD in the first place, these experiments would have to result in the realisation that the PSD could be used to multiply the position by the amplitude as in the invention. However, the Board finds no suggestion to use a PSD to perform this product. Thus the Board considers that the experiments imagined by the examining division are more in the nature of hindsight than routine design.

8. Accordingly, in the Board's view the subject-matter of the amended claim involves an inventive step (Article 56 EPC 1973).

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 department with the order to grant a patent on the basis of the claim filed during the oral proceedings before the Board and a description to be adapted.

The Registrar: The Chairman:

D. Sauter S. Steinbrener