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Datasheet for the decision of 15 January 2009

Case Number: T 0763/05 - 3.5.04

Application Number: 01304553.9

Publication Number: 1158474

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Language of the proceedings: EN

Title of invention:
Omniazimuthal visual system

Applicant:
Sharp Kabushiki Kaisha

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 123(2)
RPBA Art. 15(3)(6)

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

Keyword:
"Appellant absent at oral proceedings"
"Main request - inventive step (no)"
"Auxiliary request - added subject-matter (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0763/05 - 3.5.04

D E C I S I O N
of the Technical Board of Appeal 3.5.04
of 15 January 2009

Appellant: Sharp Kabushiki Kaisha
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 25 February 2005 refusing European application No. 01304553.9 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: F. Edlinger
Members: M. Paci
T. Karamanli

Summary of Facts and Submissions

I. The appeal is against the decision of the examining division refusing European patent application No. 01 304 553.9.

II. The following documents, cited as prior art in the decision under appeal, are relevant to the present decision:

D3: US 5 396 583 A and

D6: K. Yamazawa, et al.: "Omnidirectional Imaging with Hyperboloidal Projection", Proceedings of the 1993 IEEE/RSJ International Conference on Intelligent Robots and Systems, Yokohama, Japan, 26-30 July 1993, 1029-1034 (vol.2), ISBN: 0-7803-0823-9, DOI: 10.1109/IROS.1993.583287.

III. The decision under appeal was based on the ground that the subject-matter of claim 1 of the main request and of the first and second auxiliary requests then on file did not involve an inventive step (Article 56 EPC 1973) having regard to the disclosure of D6 and common general knowledge.

IV. With the statement of grounds of appeal the appellant submitted a main request comprising claims 1 to 11 and an auxiliary request comprising claims 1 to 9. Oral proceedings were requested in the event that the board was not minded to overturn the decision under appeal.

V. In an official communication accompanying the summons to the oral proceedings the board expressed the preliminary opinion that the subject-matter of claim 1

according to the main request did not involve an inventive step in view of D6 and common general knowledge (D3 was also cited as evidence thereof). As to the auxiliary request, the board pointed out that claim 5, dependent on claim 1, defined a combination of features which created subject-matter extending beyond the content of the application as filed, contrary to Article 123(2) EPC.

VI. With a letter dated 11 November 2008 the appellant informed the board that he would not be attending the oral proceedings. The appellant neither commented on the official communication nor submitted any amendment to his case.

VII. Oral proceedings were held on 15 January 2009 before the board in the absence of the appellant.

VIII. The appellant's requests, which were filed with the statement setting out the grounds of appeal, are that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 11 according to the main request, or on the basis of claims 1 to 9 according to the auxiliary request.

IX. Claim 1 according to the main request reads as follows:

"An omniazimuthal visual system, comprising:

an optical system (101) comprising at least one mirror having a shape of a surface of revolution, the rotation axis of the mirror being identica1 with an optical axis of an imaging lens in an imaging section (102);

an imaging section (102) for converting the image obtained through the optical system (101) into image data represented by polar coordinates;

an image transformation section (104) for transforming the image data into display data represented by rectangular coordinates;

a display section (105) for displaying a transformed image based on the display data from the image transformation section (104); and

a display control section (106) for controlling the transformed image to be displayed on the display section (105),

wherein the image transformation section (104) includes:

at least one buffer memory (108) for temporarily storing the image data and the display data;

an arithmetic/logic hardware circuit (111) for performing coordinate transformation of a polar coordinate to a rectangular coordinate without the use of software, with reference to a lookup table (110) of a trigonometric function, when the image data is transformed into the display data; and

a CPU (109) for controlling the at least one buffer memory (108), the arithmetic/logic circuit (111), and the lookup table (110),

wherein the optical system (101) is capable of obtaining an image of 360° view field area therearound and capable of central projection transformation for the image."

X. Claims 1 and 5 according to the auxiliary request read as follows:

"1. An omniazimuthal visual system, comprising:

an optical system (101) comprising a plurality of mirrors each having a shape of a surface of revolution, the plurality of mirrors including first and second mirrors;

an imaging section (102) for converting the image obtained through the optical system (101) into image data represented by polar coordinates;

an image transformation section (104) for transforming the image data into display data represented by rectangular coordinates;

a disp1ay section (105) for displaying a transformed image based on the display data from the image transformation section (104); and

a display control section (106) for controlling the transformed image to be displayed on the display section (105),

wherein the image transformation section (104) includes:

at least one buffer memory (108) for temporarily storing the image data and the display data;

an arithmetic/logic hardware circuit (111) for performing coordinate transformation of a polar coordinate to a rectangular coordinate without the use of software, with reference to a lookup table (110) of a trigonometric function, when the image data is transformed into the display data; and

a CPU (109) for controlling the at least one buffer memory (108), the arithmetic/logic circuit (111), and the lookup table (110),

wherein the optical system (101) is capable of obtaining an image of 360° view field area therearound and capable of central projection transformation for the image; wherein

the optical system (101) is structured such that

the rotation axis of the plurality of mirrors is identical with an optical axis of an imaging lens included in the imaging section,

a first principal point of the imaging lens is located at a focal point of the second mirror, and

light which travels toward a focal point of the first mirror is reflected by the first mirror and, thereafter, reflected by the second mirror so as to reach the first principal point of the imaging lens included in the imaging section; and

wherein the CPU (109) includes a parallel operation function for controlling the display control section (106), the image transformation section (104) and the display section (105)."

"5. An omniazimuthal visual system according to claim 1, wherein:

the optical system (101) includes a hyperboloidal mirror (54) having a hyperboloidal shape of one sheet of a two-sheeted hyperboloid;

a rotation axis of the hyperboloidal mirror is identical with an optical axis of an imaging lens included in the imaging section (102); and

a first principal point of the imaging lens is located at a focal point of the hyperboloidal mirror."

XI. The examining division's reasoning in the decision under appeal with respect to claim 1 of the main request then on file (which is identical to claim 1 of the main request filed with the statement of grounds of appeal) can be summarised as follows:

D6 discloses an omniazimuthal visual system, named "HyperOmni Vision", comprising all the features of the system of claim 1 except for the following:

(a) the arithmetic/logic hardware circuit performs the transformation without the use of software;

(b) at least one buffer memory (in the image transformation section) for temporarily storing the image data and the display data and

(c) a lookup table of a trigonometric function for use in the arithmetic/logic circuit when the image data is transformed into the display data.

As to feature (a), D6 merely indicates that "the image taken by HyperOmni Vision can be easily transformed..." without giving any further indication whether this transformation should be carried out by hardware or software means. However it has been well known to the person skilled in the art since the time when software for signal processing was introduced that this kind of processing has advantages and disadvantages over its hardware equivalent. In particular, it was acknowledged that the use of software is slower and therefore hardware processing is to be preferred for faster applications. Hence the suggestion of claim 1 to use hardware in order to have a faster transformation of coordinates only constitutes a possibility of solving the problem of coordinate transformation which the person skilled in the art could select according to circumstances (costs, available processing power...). Consequently this suggestion does not involve an inventive step.

Regarding feature (b), although buffer(s) are not explicitly shown in D6 it is clear for the skilled

person that the computer (such as the 16-bit computer and the workstation shown in D6) provides several buffers for its data, also for the image data.

As to feature (c), it is obvious from the skilled person's general knowledge because, when implementing the formulas set out on pages 1030 and 1031 of D6 in a hardware circuit or even in software, there are only linear operations and multipliers which can be easily implemented in hardware or with software steps. The remainder consists of trigonometric functions which are difficult to implement in both hardware operations and software steps. Especially if high-speed operation is desired there is no alternative which the skilled person could and would consider to the use of a pre-calculated table storing a trigonometric function.

Accordingly the subject-matter of claim 1 does not involve an inventive step in view of D6 and common general knowledge.

XII. The appellant argued in the statement of grounds of appeal essentially as follows:

Claim 1 of the main request - inventive step

D6 represents the closest prior art. D6 relates to an image sensor with a hyperboloidal mirror for vision based navigation of a mobile robot.

The problem to be solved by the present invention is to increase the processing speed for dynamic images (see page 5, lines 7 to 17, of the application as filed).

In the system of D6 the input image is transformed by "conventional image processing methods". It is clear that conventional processing methods at the time used software and a processor to convert the images. Therefore D6 does not suggest using dedicated hardware for image processing. Since in D6 the computer is removed from the robot, there is no need to consider further solutions. If more processing power is required, more computers can be added. The examining division's argument that a hardware implementation would be obvious is thus based on hindsight.

The examining division also argued that although no buffers are explicitly shown or disclosed in D6, it is clear for the skilled person that a computer provides several buffers for its data, and also for the image data. However there is a contradiction. If the examining division regards using a hardware image processing section as obvious, then it is not clear how this is related to the computer with buffers. Just because a computer uses buffers this does not mean that it is obvious to use buffers in the image processing section.

The examining division also regarded it as obvious from the skilled person's common general knowledge to use a lookup table of a trigonometric function. However D6 and all of the other prior art documents failed to suggest using lookup tables for trigonometric functions to enable faster image processing. At the priority date of the application the conventional method of image processing was by software. Thus there was no need to use lookup tables. The examining division's argument is again based on hindsight.

For the above reasons, the subject-matter of claim 1 involves an inventive step in view of D6 and common general knowledge (and all the other cited prior art documents).

XIII. At the end of the oral proceedings the chairman announced the board's decision.

Reasons for the Decision

1. The appeal is admissible.

2. The duly summoned appellant did not attend oral proceedings. In accordance with Article 15(3) RPBA (Rules of Procedure of the Boards of Appeal of the European Patent Office, OJ EPO 2007, 536), the board relied for its decision only on the appellant's written submissions set out in the statement of ground of appeal. The board was in a position to decide at the conclusion of the oral proceedings, since the case was ready for decision (Article 15(6) RPBA) and the voluntary absence of the appellant is not a reason for delaying a decision (Article 15(3) RPBA).

Main request

Claim 1 - inventive step (Article 56 EPC 1973)

3. Claim 1 according to the present main request is identical to claim 1 of the main request considered by the examining division in the decision under appeal.

4. It is undisputed that D6 should be regarded as the closest prior art to the subject-matter of claim 1. The board also shares this view.

5. The appellant has not disputed the finding in the appealed decision that all the features of claim 1 listed on page 4 of the appealed decision are disclosed in D6 and that the system of claim 1 only differs from D6 by the following features:

- the arithmetic/logic hardware circuit performs the transformation without the use of software;
- at least one buffer memory in the image transformation section for temporarily storing the image data and the display data and
- a lookup table of a trigonometric function for use in the arithmetic/logic circuit when the image data is transformed into the display data.

6. The board shares the examining division's conclusion (see the paragraph bridging pages 5 and 6 of the decision under appeal) that a hardware implementation making use of lookup tables for calculating trigonometric functions was a matter of normal design choice. The pros and cons of hardware and software were well known to the skilled person at the relevant time. A hardware implementation was known to be less flexible but faster than a software one. As to the use of a lookup table for a trigonometric function, as pointed out by the board in the communication accompanying the summons to the oral proceedings, D3 (see column 3, lines 3 to 51) discloses the use of a lookup table for speeding up calculations in relation to the coordinates of points on the surface of a sphere. D3 thus confirms

the examining division's assertion that such lookup tables were commonly used in a similar context. Likewise the use of at least one buffer memory for temporarily storing image data and display data is regarded by the board as a measure of usual design in the given context, whether in a software or hardware implementation, because the requirement for temporarily storing input or output data depends on the manner in which image data are input, processed and output (to a display) rather than on its implementation in software or hardware (see, for example, paragraphs [0025] and [0052] of the published application).

7. For the above reasons, the board considers that the examining division's arguments are not based on inadmissible hindsight and judges that the subject-matter of claim 1 does not involve an inventive step in view of D6 and common general knowledge.

8. Hence the appellant's main request is not allowable.

Auxiliary request

Claim 5 - added subject-matter (Article 123(2) EPC)

9. Claim 5 (dependent on claim 1) according to the auxiliary request defines an omniazimuthal visual system comprising both a plurality of mirrors and a hyperboloidal mirror. This combination of features was not disclosed in the application as originally filed. The only embodiment of a system with more than one mirror was that shown in figure 9 of the application as filed. According to the description of figure 9, these mirrors were paraboloidal or, defined in more general

terms, had "a shape of a surface of revolution" (see paragraph [0085] of the published application). There is however no specific disclosure combining a hyperboloidal mirror and a plurality of mirrors having "a shape of a surface of revolution" (as used in the embodiment of figure 9).

The amendments made to claim 1 thus extend the subject-matter of the application beyond the content of the application as filed, contrary to Article 123(2) EPC.

10. For this reason the appellant's auxiliary request is also not allowable.

11. Since none of the appellant's requests are allowable, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

L. Fernández Gómez F. Edlinger