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Datasheet for the decision of 3 April 2014

Case Number: T 2388/10 - 3.5.04

Application Number: 03018684.5

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Title of invention:
Intruding-object detection apparatus

Applicant:
Fuji Jukogyo Kabushiki Kaisha

Headword:

Relevant legal provisions:
EPC 1973 Art. 56

Keyword:
Inventive step - after amendment

Decisions cited:

Catchword:

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Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 2388/10 - 3.5.04

D E C I S I O N
of Technical Board of Appeal 3.5.04
of 3 April 2014

Appellant: (Applicant)	Fuji Jukogyo Kabushiki Kaisha 7-2 Nishi Shinjuku 1-chome Shinjuku-ku Tokyo (JP)
Representative:	Vossius & Partner Siebertstraße 4 81675 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 19 May 2010 refusing European patent application No. 03018684.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: M. Paci
Members: R. Gerdes
C. Vallet

Summary of Facts and Submissions

I. The appeal is directed against the decision to refuse European patent application No. 03 018 684.5, published as European patent application EP 1 395 059 A2.

II. The patent application was refused by the examining division on the grounds that the subject-matter of claim 1 of the main request and claim 1 of the auxiliary request did not involve an inventive step (Article 56 EPC) in view of each of the following documents as well as in view of their combination:

D1: EP 0 686 942 A2
D2: US 2001/0048470 A1.

The examining division also found that claim 1 of the main request did not comply with Article 84 EPC.

III. The applicant appealed against this decision and with the statement of grounds of appeal submitted claims of a new main request as well as of a new auxiliary request.

IV. In a communication annexed to a summons to oral proceedings the board raised *inter alia* objections regarding the clarity of the claims.

V. With a letter of reply dated 27 February 2014 the appellant submitted amended claims according to a main request and an auxiliary request, replacing the claims on file.

VI. Oral proceedings were held before the board on 3 April 2014. The appellant's final requests at the end

of the oral proceedings were that the decision under appeal be set aside and that a patent be granted on the basis of the following documents:

- description pages 1, 2, 2a, 3 to 20 filed during the oral proceedings held on 3 April 2014,
- claims 1 to 7 filed during the oral proceedings held on 3 April 2014,
- drawing sheets 1/4 to 4/4 of the application as filed.

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

"An intruding-object detection apparatus for detecting an object intruding into a field of view as an intruding object using a pair of images (5) taken by a stereo camera (1), the pair of images being a reference image and a comparison image, said apparatus comprising:

means for obtaining a matching point for every position in the reference image between the reference image and the comparison image of a background and for storing the deviation associated with each obtained matching point; and

means for performing an intruding-object detection process by evaluating the difference between the brightness of a position in the reference image and the brightness of a corresponding position in the comparison image, said corresponding position deviating from the position in the reference image by the stored deviation associated with said position in the reference image, and for outputting said position of the reference image if the absolute value of said difference is larger than a predetermined threshold value as a position indicating an intruding object;

wherein said intruding-object detection process performs the evaluation of the brightness difference for all positions in the reference image every period of motion pictures."

VIII. The examining division held in the decision under appeal that D1 represented the closest prior art. D1 did not disclose how the disparity change referred to on page 8, lines 11 to 13, of D1 was derived. Nevertheless, it was obvious that an initially calculated disparity should be used. It made no sense to repeat the calculation of disparity. Moreover, it was "obvious for the skilled person who has knowledge of D1, including the basic epipolar analysis of stereo images, see for example page 2 of D1, that if an intruder is to be detected by 'disparity change', then the change results for some points in the images from one camera 'seeing' a point in the image which is now obscured by the intruder for the second camera." Thus, it was obvious "to use the already calculated disparity information to detect the change in disparity by using the displacement representing the disparity".

With reference to D2, paragraph [0026], it was argued that D2 rendered the idea of using stored matching points obvious. Hence, the subject-matter of claim 1 then on file was obvious in view of D1 when taken alone or in view of the combination of D1 and D2.

In addition, the subject-matter of claim 1 was also obvious in view of D2 alone. It was accepted that D2 did not explicitly mention a comparison of the parallaxes obtained in the background analysis step and the intruding-object detection process. However, this comparison was obvious in view of paragraph [0026] of D2 (see decision under appeal, Reasons, point 3).

IX. The appellant argued that the examining division had misinterpreted D1. The intruding-object detection phase in D1 comprised a repetitive computation of parallaxes from sets of stereo images. D1 did not disclose or suggest a step of comparing the brightness difference in two images with a threshold to determine an intruding object. This feature eliminated the need to calculate a parallax at a later stage.

With regard to D2, the appellant argued that the document did not disclose how a reference image could be transferred to a comparison image. It also did not disclose calculating a matching point in advance (see statement of grounds, pages 2 to 4).

Reasons for the Decision

1. The appeal is admissible.

Amendments (Article 123(2) EPC)

2. Compared with the claims of the main request underlying the decision under appeal, present claim 1 has been amended to clarify that the apparatus includes means for obtaining matching points *for every position in the reference image.* It has also been clarified that *the deviation associated with each obtained matching point* is stored. In addition, it has been specified that the means for performing the intruding-object detection evaluate *the difference between the brightness of a position in the reference image and the brightness of a corresponding position in the comparison image, said corresponding position deviating from the position in*

the reference image by the stored deviation associated with the position in the reference image. The position in the reference image is output as a position indicating an intruding object *if the absolute value of said difference is larger than a predetermined threshold value* (amendments highlighted in italics).

3. A basis for these amendments can be found in the application as filed on page 7, line 24, to page 8, line 2; page 8, line 18, to page 9, line 3; page 9, lines 6 and 7; page 9, line 14, to page 10, line 23; page 14, lines 8 to 10. Hence, the board finds that the claims of the appellant's sole request do not contain subject-matter which extends beyond the content of the application as filed and that they thus comply with Article 123(2) EPC.

Inventive step

4. It is common ground that D1 may be considered as the closest prior art with respect to the subject-matter of claim 1.

4.1 D1 relates to an intruding-object detection apparatus for detecting obstacles or intruders in a railway crossing. The apparatus comprises two cameras in a stereo camera setup to generate a reference and a comparison image. According to the prior art that is referred to in D1, matching points in the two images are determined by searching for the maximum correlation of small areas in the reference image and in the comparison image. The disparity or parallax of the matching points is stored and compared with the disparity in subsequent image sets to determine whether an object has entered the field of view of the cameras

(see D1, page 2, lines 5 to 58, and page 3, lines 46 to 48).

D1 proposes an improved method to reduce the amount of computations for the correlation. The stereo images are filtered to extract edges and, subsequently, the filtered images are subjected to ternary thresholding, i.e. the image information is classified into one of a negative edge, no edge, and a positive edge. Blocks of pixels having ternary values are subsequently correlated to determine the disparity values. Due to the representation of pixels using ternary values and the correlation of blocks of ternary values, the measuring of disparity change is accelerated (see D1, page 3, lines 32 to 48; page 5, line 21, to page 6, line 28; page 8, lines 6 to 13).

Hence, D1 proposes a repeated determination of disparities in the stereo images by a (time-consuming) correlation process. The determination of disparities in subsequent stereo images is performed independently of any previously computed disparities. It is only in a subsequent step that disparities are compared to those obtained for an earlier set of stereo images in order to detect objects intruding into the field of view of the stereo cameras (see page 5, line 54, to page 6, line 7; page 6, lines 27 to 39; page 8, lines 6 to 13).

4.2 D1 does not disclose means for performing an intruding-object detection process as specified in claim 1.

According to the present invention and as specified in claim 1, stored (background) deviation values, which were determined by the means for obtaining a matching point, are used by the means for performing the intruding-object detection process to determine

hypothetical matching points in a subsequent set of stereo images, the hypothetical matching points being at the same positions as in the previous set of stereo images. The brightnesses of these hypothetical matching points in the subsequent set of stereo images are compared. If the observed scene has not changed, the brightnesses at the hypothetical matching points should still correlate. By contrast, if an object has entered the field of view, the parallax values will have changed and the brightnesses of the matching points will in general deviate from one another. Hence, if the absolute value of the difference of brightnesses is larger than a threshold, the position is considered to indicate an intruding object (see also the present application, page 11, line 6, to page 12, line 3). These features of the apparatus of claim 1 allow faster detection of an intruding object than in D1 because a comparison process of the brightness of already stored matching points is less time-consuming than a correlation process for finding matching points.

4.3 Similarly to D1, the apparatus according to the present application reduces the necessary amount of operations for detecting intruding objects. The technical problem can therefore be formulated as how to further reduce the computational burden for detecting intruding objects using a stereo camera system.

4.4 D1 reduces the computational burden by improving the correlation process. In contrast, the apparatus of claim 1 removes the need for a repetition of the correlation process by using a brightness comparison process instead. D1 does not suggest or hint at this solution.

4.5 It follows that the subject-matter of claim 1 is not obvious in view of D1 alone.

5. In the decision under appeal D2 was also considered as being highly relevant with respect to the claimed subject-matter.

5.1 D2 discloses an apparatus "for driving door installations as a function of the presence of a person wherein the region of the door installation is continuously observed by at least one videocamera." D2 is primarily focused on a solution employing a single camera, which is used to take a reference image of the space in front of the door installation. A "plan model" of the space is extracted either from the obtained image or input through manual entry. Subsequent images are analysed to detect objects entering the field of view of the camera. Based on the co-ordinates of any detected object and on a comparison with the stored model, the type and direction of the movement of the object may be determined (see D2, abstract, figures 4 and 5 and paragraphs [0005], [0006], [0008] to [0015]).

D2 also refers to the use of a stereo camera instead of a single monocular video camera. In this context D2 states that "the image of the one camera can be transferred to the image to be expected from the second camera and by comparison of the calculated and effectively received image conclusions can be drawn regarding the presence and/or changes of objects in the image area." Details as to how the image of one camera is transferred or how the calculated and effectively received images are compared are not disclosed (see paragraphs [0025] to [0028], [0056], figure 7 as well as claims 13 and 14).

5.2 Hence, D2 discloses the transfer of one image of a set of stereo images to the other. D2 does not deal with subsequent sets of stereo images and using matching points extracted in one set of stereo images to simplify operations in a subsequent set of stereo images. In addition, D2 provides no details as to which image elements of the first image may be transferred to the second image and be compared with the effectively received image.

5.3 As a result, D2 alone cannot be considered to render the subject-matter of claim 1 obvious.

6. Also by combining D1 and D2 the skilled person would not have arrived at the claimed subject-matter. As set out above, neither of the two documents discloses the use of the stored deviation between matching points in a first set of stereo images to evaluate a difference in brightness of corresponding positions in a subsequent set of stereo images.

7. In summary, the subject-matter of claim 1 would not have been obvious for the person skilled in the art in view of D1 or D2 or a combination of D1 and D2, and thus it involves an inventive step in view of the cited prior art (Article 56 EPC 1973).

8. The same conclusion also applies to the subject-matter of claims 2 to 7 because of their dependency on claim 1.

9. It follows from the above that the appellant's request is allowable.

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 on the basis of the following documents:

   - description pages 1, 2, 2a, 3 to 20 filed during the oral proceedings held on 3 April 2014,
   - claims 1 to 7 filed during the oral proceedings held on 3 April 2014,
   - drawing sheets 1/4 to 4/4 of the application as filed.

The Registrar: The Chairman:

K. Boelicke M. Paci

Decision electronically authenticated