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(12) **United States Patent**
Pirim

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(54) **IMAGE PROCESSING METHOD**

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(73) Assignee: **Image Processing Technologies LLC**, Suffern, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 528 days.

This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

(60) Continuation of application No. 11/676,926, filed on Feb. 20, 2007, now Pat. No. 7,650,015, which is a division of application No. 09/792,294, filed on Feb. 23, 2001, now Pat. No. 7,181,047, which is a continuation-in-part of application No. 09/230,502, filed on Sep. 13, 1999, now Pat. No. 6,486,909, which is a continuation-in-part of application No. PCT/EP98/05383, filed on Aug. 25, 1998, and a continuation-in-part of application No. PCT/FR97/01354, filed on Jul. 22, 1997.

(30) **Foreign Application Priority Data**

Jul. 22, 1996 (FR) 96 09420

(51) **Int. Cl.**
G06K 9/00 (2006.01)

(52) **U.S. Cl.**
USPC **382/103**; 382/128; 382/168

(58) **Field of Classification Search**
USPC 382/100, 103, 107, 128–132, 168–180, 382/199–206, 224, 291
See application file for complete search history.

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Primary Examiner — Manav Seth

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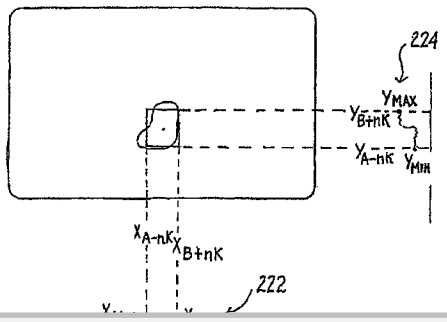
(57) **ABSTRACT**

A method and apparatus for localizing an area in relative movement and for determining the speed and direction thereof in real time is disclosed. Each pixel of an image is smoothed using its own time constant. A binary value corresponding to the existence of a significant variation in the amplitude of the smoothed pixel from the prior frame, and the amplitude of the variation, are determined, and the time constant for the pixel is updated. For each particular pixel, two matrices are formed that include a subset of the pixels spatially related to the particular pixel. The first matrix contains the binary values of the subset of pixels. The second matrix contains the amplitude of the variation of the subset of pixels. In the first matrix, it is determined whether the pixels along an oriented direction relative to the particular pixel have binary values representative of significant variation, and, for such pixels, it is determined in the second matrix whether the amplitude of these pixels varies in a known manner indicating movement in the oriented direction. In each of several domains, histogram of the values in the first and second matrices falling in such domain is formed. Using the histograms, it is determined whether there is an area having the characteristics of the particular domain. The domains include luminance, hue, saturation, speed (V), oriented direction (D1), time constant (CO), first axis (x(m)), and second axis (y(m)).

13 Claims, 13 Drawing Sheets



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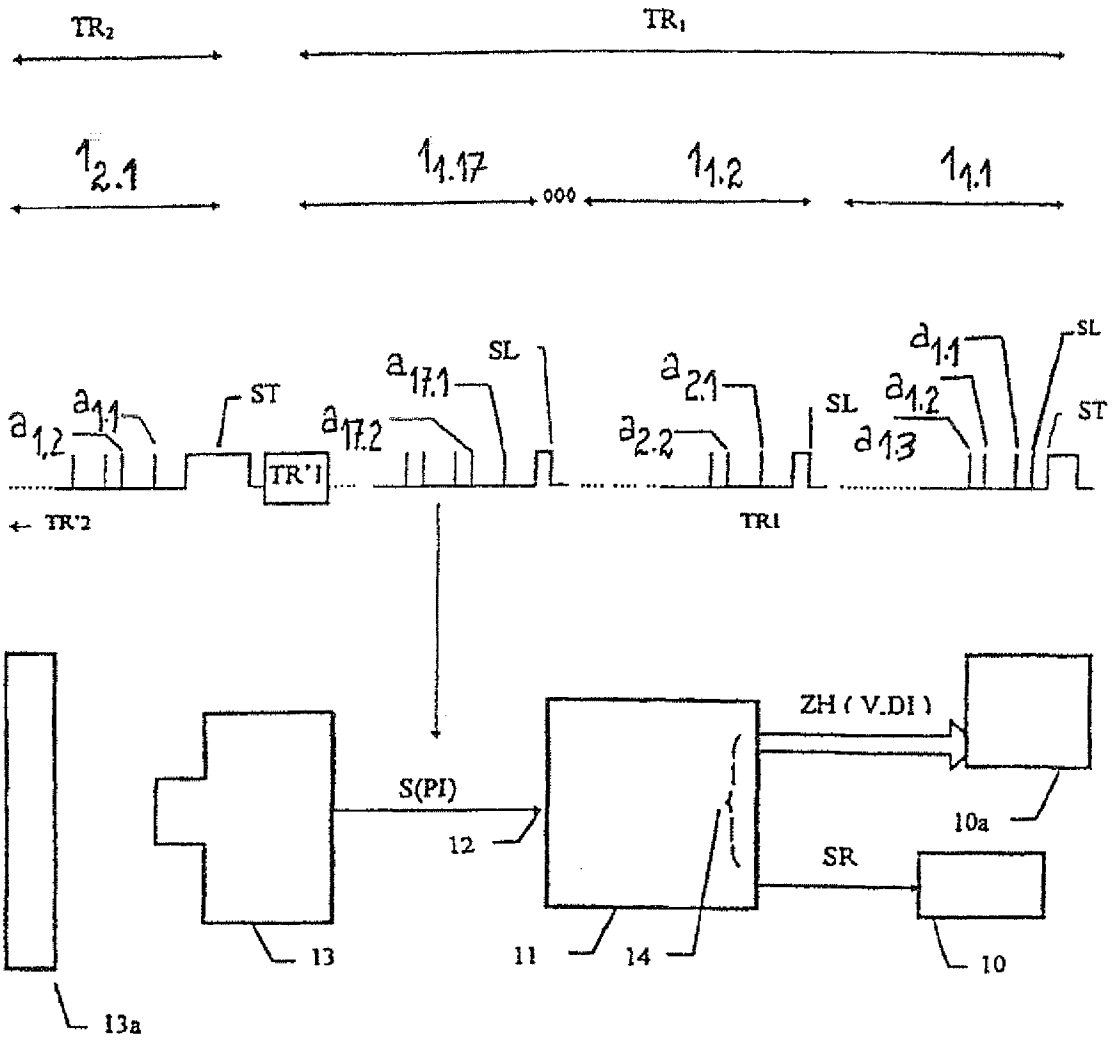


FIG. 1

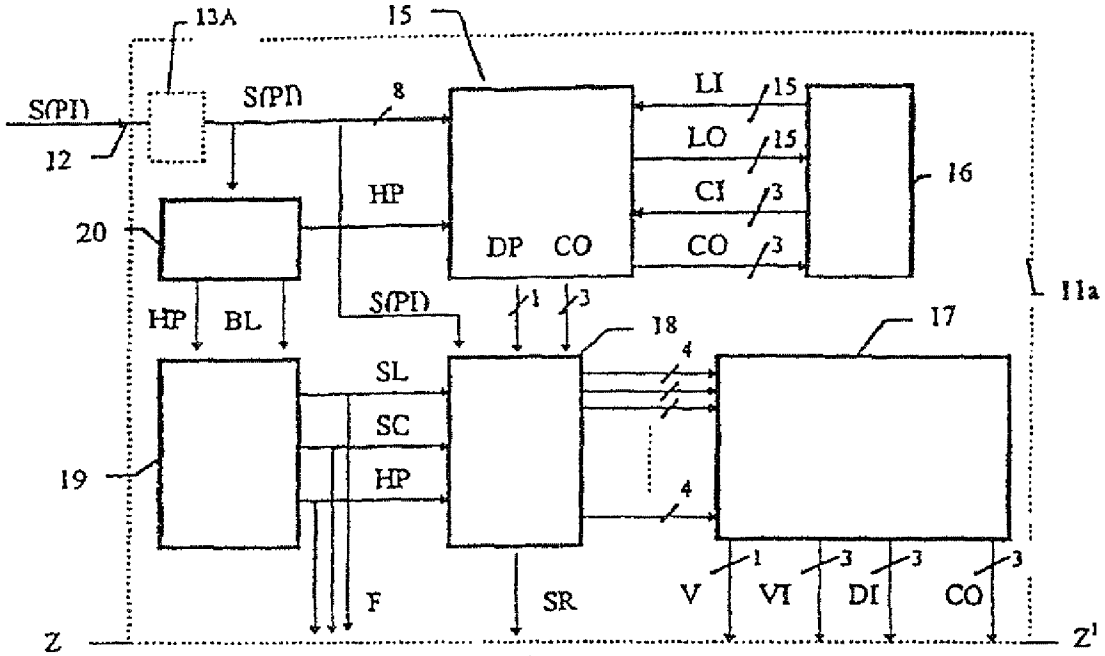
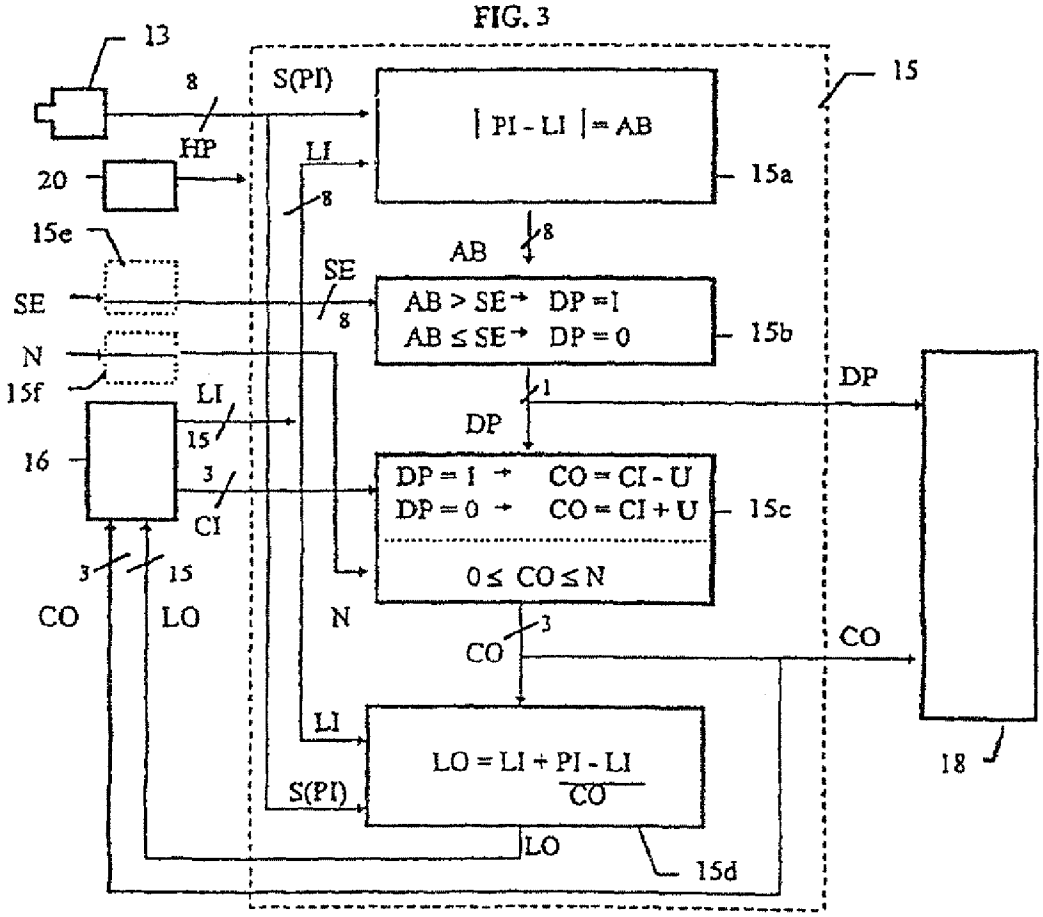


FIG. 2

FIG. 3



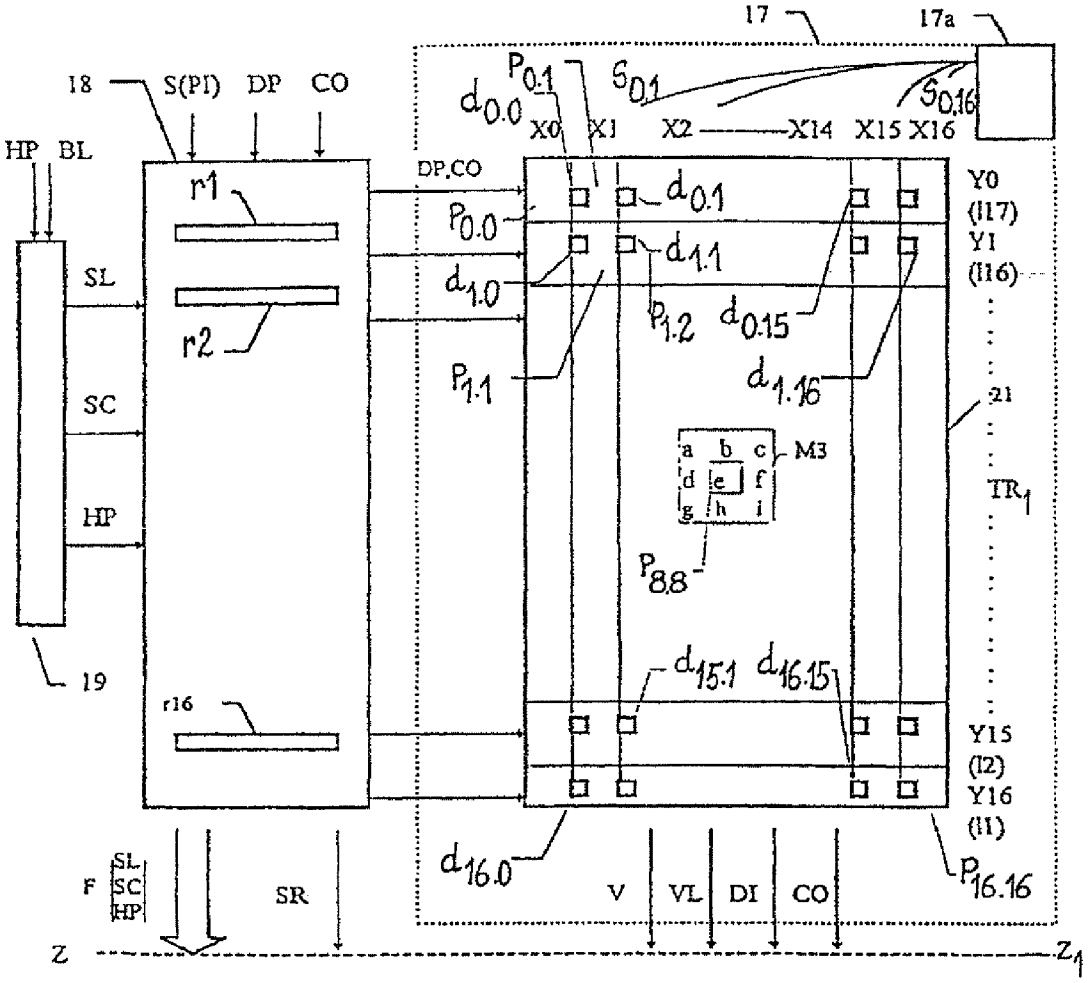


FIG. 4

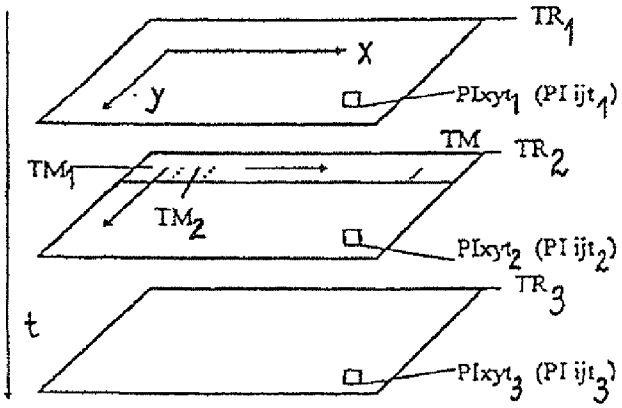


FIG. 5

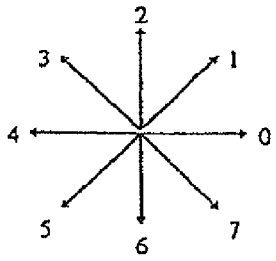


FIG. 6

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