



US008989445B2

(12) **United States Patent**
Pirim

(10) **Patent No.:** **US 8,989,445 B2**
(45) **Date of Patent:** **Mar. 24, 2015**

(54) **IMAGE PROCESSING APPARATUS AND METHOD**

(71) Applicant: **Image Processing Technologies LLC**,
Suffern, NY (US)

(72) Inventor: **Patrick Pirim**, Paris (FR)

(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 0 days.

(21) Appl. No.: **14/449,809**

(22) Filed: **Aug. 13, 2014**

(65) **Prior Publication Data**

US 2015/0023559 A1 Jan. 22, 2015

Related U.S. Application Data

(60) Continuation of application No. 14/215,358, filed on Mar. 17, 2014, which is a continuation of application No. 12/620,092, filed on Nov. 17, 2009, now Pat. No. 8,805,001, which is a continuation of application No.

(Continued)

(30) **Foreign Application Priority Data**

Jul. 26, 1996 (FR) 96 09420

(51) **Int. Cl.**

G06K 9/00 (2006.01)
G06T 7/20 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC **G06T 7/2033** (2013.01); **G06K 9/6212** (2013.01); **H04N 5/23296** (2013.01); **G06T 2207/10016** (2013.01); **G06T 2207/30241** (2013.01)

USPC **382/103**; 382/128; 382/168; 348/143

(58) **Field of Classification Search**

None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,725,576 A 4/1973 Crawford et al.
3,760,377 A 9/1973 Attridge et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0046110 2/1982
EP 0380659 8/1990

(Continued)

OTHER PUBLICATIONS

“British firm has eye on the future”, Business & Technology (Nov. 18, 1997) 4th Edition.

(Continued)

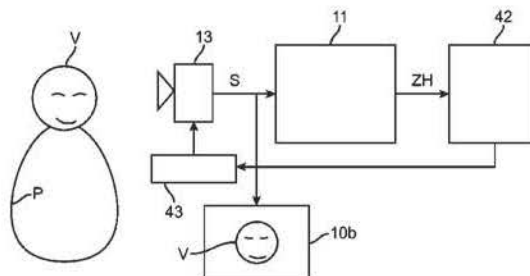
Primary Examiner — Manav Seth

(74) *Attorney, Agent, or Firm* — Novak Druce Connolly Bove + Quigg, LLP

(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)).

30 Claims, 13 Drawing Sheets



Related U.S. Application Data

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 as application No. PCT/FR97/01354 on Jul. 22, 1997, now Pat. No. 6,486,909, and a continuation-in-part of application No. PCT/EP98/05383, filed on Aug. 25, 1998.

- (51) **Int. Cl.**
G06K 9/62 (2006.01)
H04N 5/232 (2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,364,089	A	12/1982	Woolfson	
4,386,848	A	6/1983	Clendenin et al.	
4,706,120	A *	11/1987	Slaughter et al.	348/114
4,719,584	A	1/1988	Rue et al.	
4,783,828	A	11/1988	Sadjadi	
4,847,786	A	7/1989	Wang et al.	
4,868,871	A	9/1989	Watson, III	
H713	H	11/1989	May et al.	
4,906,940	A	3/1990	Greene et al.	
5,008,946	A	4/1991	Ando	
5,059,796	A	10/1991	Nakamura	
5,088,488	A	2/1992	Markowitz et al.	
5,109,425	A	4/1992	Lawton	
5,123,055	A	6/1992	Kasdan	
5,163,095	A	11/1992	Kosaka	
5,164,992	A	11/1992	Turk et al.	
5,181,254	A	1/1993	Schweizer et al.	
5,247,583	A	9/1993	Kato et al.	
5,263,098	A	11/1993	Horikami	
5,278,921	A	1/1994	Nakamura et al.	
5,280,530	A	1/1994	Trew et al.	
5,323,470	A	6/1994	Kara et al.	
5,359,533	A	10/1994	Ricka et al.	
5,360,968	A	11/1994	Scott	
5,384,865	A	1/1995	Loveridge	
5,426,684	A	6/1995	Gaborski et al.	
5,430,809	A	7/1995	Tomitaka	
5,452,367	A	9/1995	Bick et al.	
5,473,369	A	12/1995	Abe	
5,481,622	A	1/1996	Gerhardt et al.	
5,488,430	A	1/1996	Hong	
5,500,904	A	3/1996	Markandey et al.	
5,521,843	A *	5/1996	Hashima et al.	700/253
5,546,475	A *	8/1996	Bolle et al.	382/190
5,565,920	A	10/1996	Lee et al.	
5,574,498	A	11/1996	Sakamoto et al.	
5,592,226	A	1/1997	Lee et al.	
5,592,237	A	1/1997	Greenway et al.	
5,604,822	A	2/1997	Pearson et al.	
5,608,820	A	3/1997	Vaidyanathan	
5,610,653	A	3/1997	Abecassis	
5,625,717	A	4/1997	Hashimoto et al.	
5,630,037	A *	5/1997	Schindler	345/592
5,631,697	A	5/1997	Nishimura et al.	
5,644,386	A	7/1997	Jenkins et al.	
5,684,715	A	11/1997	Palmer	
5,694,495	A	12/1997	Hara et al.	
5,712,729	A	1/1998	Hashimoto	
5,717,784	A	2/1998	Yanagishita et al.	
5,774,581	A	6/1998	Fassnacht et al.	
5,781,650	A	7/1998	Lobo et al.	
5,793,888	A	8/1998	Delanoy et al.	
5,798,787	A	8/1998	Yamaguchi et al.	
5,812,193	A	9/1998	Tomitaka et al.	
5,825,922	A	10/1998	Pearson et al.	
5,883,969	A	3/1999	Le Gouzouguec et al.	

5,930,379	A	7/1999	Rehg et al.	
5,982,909	A	11/1999	Erdem et al.	
5,982,944	A	11/1999	Vaidyanathan et al.	
6,005,493	A	12/1999	Taniguchi et al.	
6,037,976	A	3/2000	Wixson	
6,049,363	A	4/2000	Courtney et al.	
6,084,989	A	7/2000	Eppler	
6,148,092	A	11/2000	Qian	
6,226,388	B1	5/2001	Qian et al.	
6,256,608	B1	7/2001	Malvar	
6,263,088	B1	7/2001	Crabtree et al.	
6,263,089	B1	7/2001	Otsuka et al.	
6,295,367	B1	9/2001	Crabtree et al.	
6,301,370	B1	10/2001	Steffens et al.	
6,304,187	B1	10/2001	Pirim	
6,312,385	B1	11/2001	Mo et al.	
6,335,985	B1	1/2002	Sambonsugi et al.	
6,339,651	B1	1/2002	Tian et al.	
6,381,363	B1	4/2002	Murching et al.	
6,400,830	B1	6/2002	Christian et al.	
6,434,254	B1	8/2002	Wixson	
6,453,069	B1	9/2002	Matsugu et al.	
6,486,909	B1	11/2002	Pirim	
6,597,738	B1	7/2003	Park et al.	
6,704,045	B1	3/2004	Brett	
6,714,665	B1	3/2004	Hanna et al.	
6,717,518	B1	4/2004	Pirim et al.	
7,181,047	B2	2/2007	Pirim	
7,190,725	B2	3/2007	Pirim	
7,650,015	B2	1/2010	Pirim	
8,116,527	B2	2/2012	Sabol et al.	
8,805,001	B2	8/2014	Pirim	
2002/0071595	A1	6/2002	Pirim	
2002/0101432	A1	8/2002	Ohara et al.	
2002/0120594	A1	8/2002	Pirim	
2002/0156753	A1	10/2002	Pirim	
2002/0169732	A1	11/2002	Pirim	
2003/0067978	A1	4/2003	Pirim	
2003/0152267	A1	8/2003	Pirim	
2007/0140526	A1	6/2007	Pirim	

FOREIGN PATENT DOCUMENTS

EP	0394959	10/1990
EP	0574831	12/1993
EP	2751772	1/1998
FR	2611063	8/1988
FR	2751772	1/1998
JP	06205780	7/1994
JP	11150676	6/1999
WO	9805002	2/1998
WO	9936694	7/1999
WO	9936893	7/1999
WO	9936894	7/1999
WO	0011609	3/2000
WO	0011610	3/2000
WO	0011639	3/2000
WO	0163557	8/2001

OTHER PUBLICATIONS

“Elektronik revue”, Eine Elsevier-Thomas-Publikation, Jahrgang (Mar. 8, 1997) ISSN: 0939-1134.

“Inside the Pentagon’s, inside missile defense, an exclusive biweekly report on U.S. missile defense programs, procurement and policymaking”, Missile Technology (Aug. 13, 1997) 3(16): 5.

“Le mecanisme de la vision humaine dans le silicum”, Electronique Le Mensuel des Ingenieurs de Conception (1997) 68: 1157-1151.

“Objectif securite des reseaux”, Es Professionnels de L’informatique en Enterprise Magazine (Jan. 1997).

“Realiser un decodeur pour TV numerique”, Electronique, Le Mensuel des Ingenieurs de Conception (1997) 66.

“Techniques de l’ingenieur”, Revue Trimestrielle Des (Mar. 1997) 5(40F). ISSN 0994-0758.

(56)

References Cited

OTHER PUBLICATIONS

Daugman, "Complete discrete 2-D Gabor transforms by neural networks for image analysis and compression", IEEE Transaction on Acoustics, Speech and Signal Processing (1988) 36(7): 1169-14179.
Groupe Revenu Francais, Air & Co, "Un calculateur de perception visuelle", Hebdomadaire, (Dec. 6, 1996) Annee No. 1590: 22F.
Grove et al., "Colour based object tracking", IEEE (Aug. 1998). (4 pages).
Gru Svelte, "Premier . . . oeil", Electronicque International Hebdo (Dec. 1996): 245.
Indiveri et al., "System implementation of analog VLSI velocity sensor", IEEE Proceedings of MicroNeuro (1996): 15-22.
Johnson, "Vision chip's circuitry has its eye out for you", Retrieved from <http://192.215.107.74/wire/news/1997/09/09013vision.html> (3 pages), 1997.

Mallat, "A theory for multiresolution signal decomposition: The wavelet representation", IEEE Transactions on Pattern Analysis and Machine Intelligence (1989) 11(7): 674-693.
Parleur, "Un processor de perception visuelle", Des Solutions Electroniques Pour Tous (1997) 25F: 1856.
Revue Trimestrielle, "Instantanes Technique", Techniques de Ingenieur (1997). ISSN: 0994-0758.
Ruedi, "Motion detection silicon retina based on event correlations", IEEE Proceedings of MicroNeuro (1996): 23-29.
Swain et al., "Indexing via color histograms", IEEE (1990): 390-393.
Tomita, Jr. et al., "Hand shape extraction from a sequence of digitized gray-scale images", IECON 20th International Conference on Industrial Electronics, Control and Instrumentation (1994) 3: 1925-1930.
Yamada et al., "Image understanding based on edge hologram method for rear-end collision avoidance system", Vehicle Navigation & Information Systems Conference Proceedings (1994): 445-450.

* cited by examiner

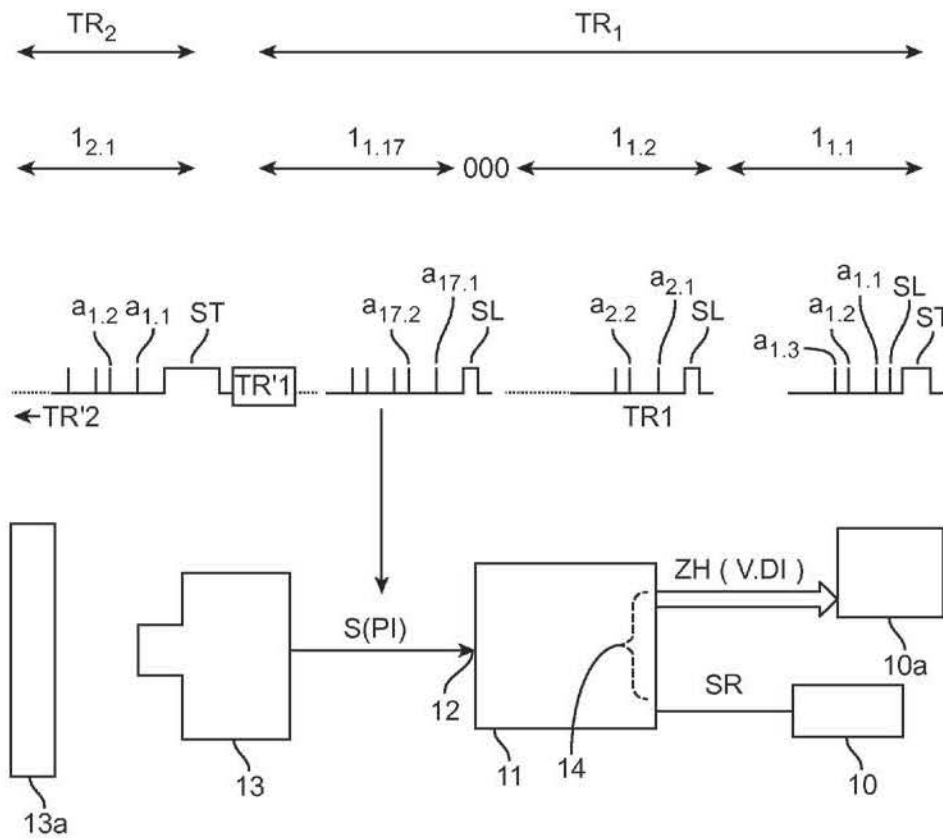


FIG. 1

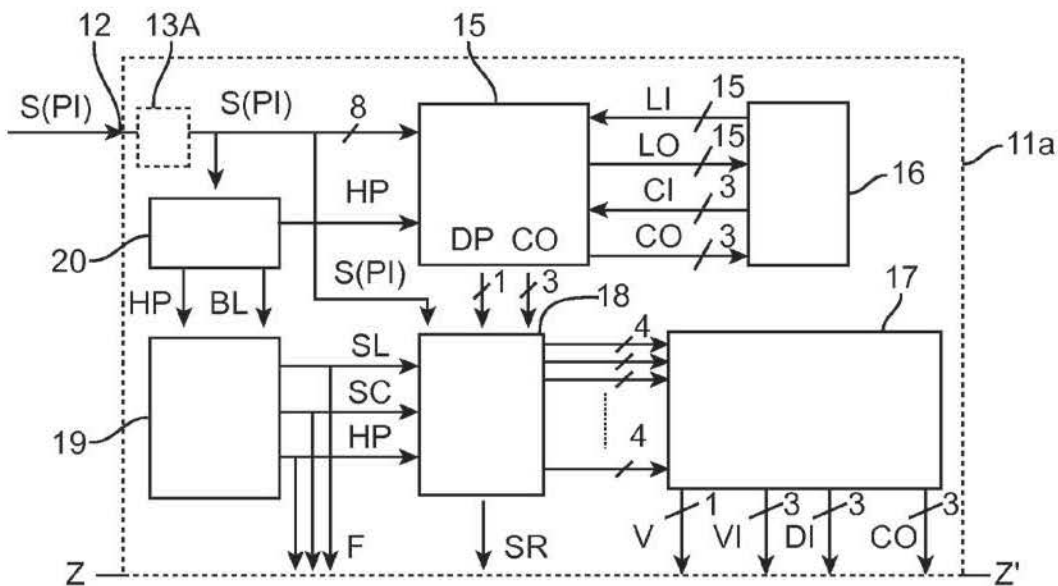


FIG. 2

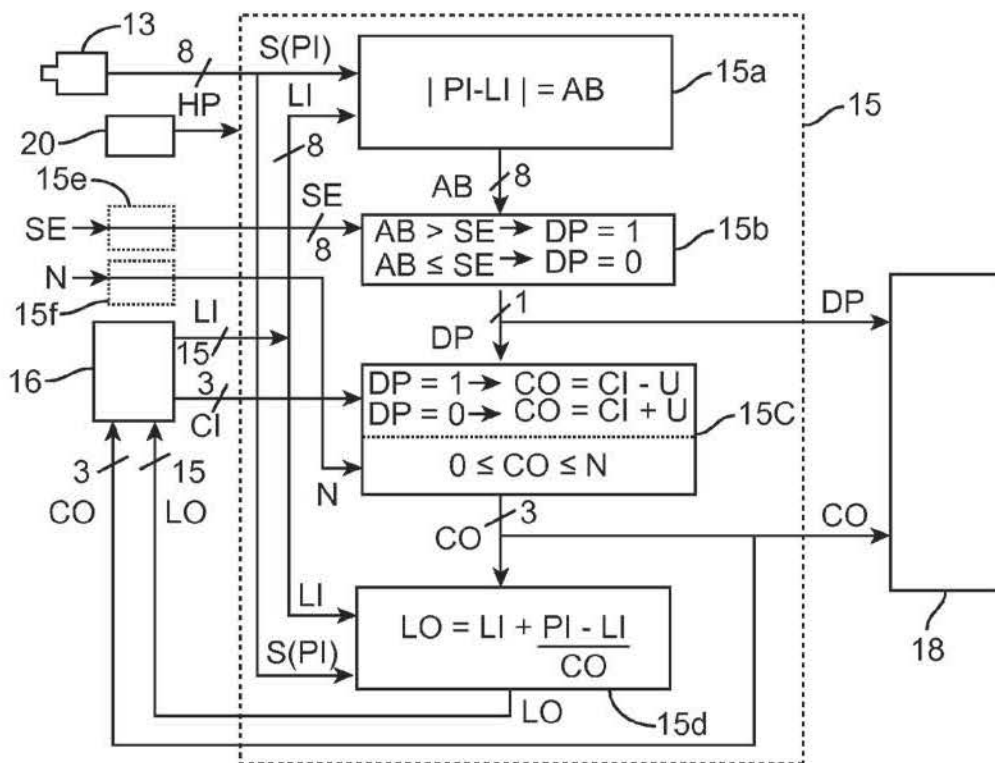


FIG. 3

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.