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(54) **VIDEO ANALYTIC RULE DETECTION SYSTEM AND METHOD**

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None
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(56) **References Cited**
U.S. PATENT DOCUMENTS

3,812,278 A 5/1974 Aker
3,812,287 A 5/1974 Lemelson
3,988,533 A 10/1976 Mick et al.
(Continued)

FOREIGN PATENT DOCUMENTS

DE 4430016 A1 2/1996
DE 19848490 A1 4/2000
(Continued)

OTHER PUBLICATIONS

Notification of Defects for IL 161777 (original and translation), Feb. 21, 2008.

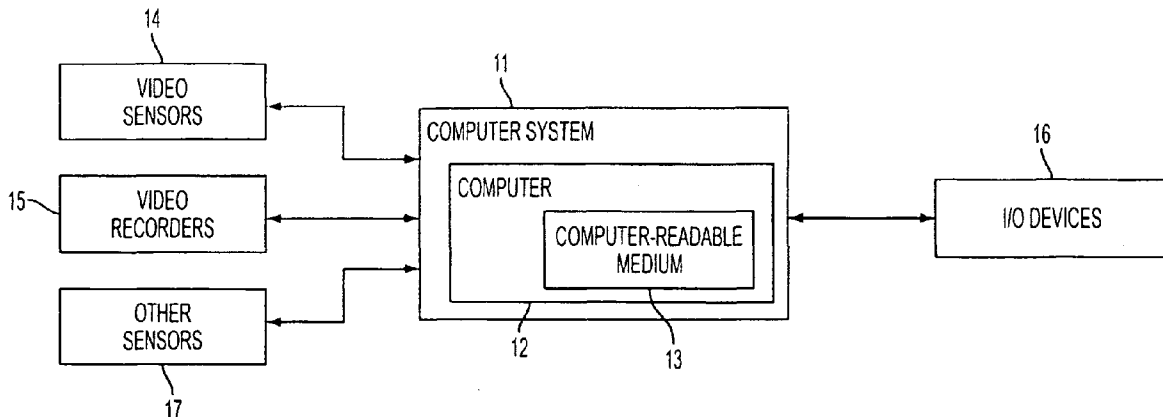
(Continued)

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(57) **ABSTRACT**

A video surveillance system is set up, calibrated, tasked, and operated. The system extracts video primitives and extracts event occurrences from the video primitives using event discriminators. The extracted video primitives and event occurrences may be used to create and define additional video analytic rules. The system can undertake a response, such as an alarm, based on extracted event occurrences.

32 Claims, 25 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

4,160,998	A	7/1979	Kamin	6,025,877	A	2/2000	Chang et al.	
4,198,653	A	4/1980	Kamin	6,028,626	A	*	Aviv	348/152
4,249,207	A	2/1981	Harman et al.	6,031,573	A	2/2000	MacCormack et al.	
4,257,063	A	3/1981	Loughry et al.	6,044,166	A	3/2000	Bassman et al.	
4,458,266	A	7/1984	Mahoney	6,049,363	A	4/2000	Courtney et al.	
4,593,274	A	6/1986	Rizzo	6,058,210	A	5/2000	de Queiroz et al.	
4,737,847	A	4/1988	Araki et al.	6,067,112	A	5/2000	Wellner et al.	
4,764,971	A	8/1988	Sullivan	6,069,653	A	5/2000	Hudson	
4,857,912	A	8/1989	Everett, Jr. et al.	6,069,655	A	5/2000	Seeley et al.	
4,908,704	A	3/1990	Fujioka et al.	6,075,560	A	6/2000	Katz	
4,941,182	A	7/1990	Patel	6,078,619	A	6/2000	Monro et al.	
4,943,854	A	7/1990	Shiota et al.	6,084,912	A	7/2000	Reitmeier et al.	
4,949,389	A	8/1990	Allebach et al.	6,088,484	A	7/2000	Mead	
5,048,095	A	9/1991	Bhanu et al.	6,091,771	A	7/2000	Seeley et al.	
5,091,780	A	2/1992	Pomerleau	6,091,846	A	7/2000	Lin et al.	
5,099,322	A	3/1992	Gove	6,097,429	A	8/2000	Seeley et al.	
5,159,647	A	10/1992	Burt	6,108,033	A	8/2000	Ito et al.	
5,161,107	A	11/1992	Mayeaux et al.	6,123,123	A	9/2000	Carder et al.	
5,229,850	A	7/1993	Toyoshima	6,128,396	A	10/2000	Hasegawa et al.	
5,296,852	A	3/1994	Rathi	6,128,398	A	*	Kuperstein et al.	382/118
5,321,396	A	6/1994	Lamming et al.	6,144,375	A	11/2000	Jain et al.	
5,448,315	A	9/1995	Soofoo	6,151,413	A	11/2000	Jang et al.	
5,448,651	A	9/1995	Sakou et al.	6,166,744	A	12/2000	Jaszlics et al.	
5,465,115	A	11/1995	Conrad et al.	6,167,143	A	12/2000	Badique	
5,485,611	A	1/1996	Astle	6,177,886	B1	1/2001	Billington et al.	
5,491,511	A	2/1996	Odle	6,182,022	B1	1/2001	Mayle et al.	
5,515,453	A	5/1996	Hennessey et al.	6,188,381	B1	2/2001	van der Wal et al.	
5,519,789	A	5/1996	Etoh	6,188,777	B1	2/2001	Darrell et al.	
5,521,634	A	5/1996	McGary	6,195,458	B1	2/2001	Warnick et al.	
5,526,133	A	6/1996	Paff	6,201,473	B1	3/2001	Schaffer	
5,576,972	A	11/1996	Harrison	6,201,476	B1	3/2001	Depeursinge et al.	
5,586,200	A	12/1996	Devaney et al.	6,205,239	B1	3/2001	Lin et al.	
5,602,585	A	2/1997	Dickinson et al.	6,211,907	B1	4/2001	Scaman et al.	
5,610,653	A	3/1997	Abecassis	6,226,388	B1	5/2001	Qian et al.	
5,621,889	A	4/1997	Lermuzeaux et al.	6,249,613	B1	6/2001	Crinon et al.	
5,623,249	A	4/1997	Camire	6,278,466	B1	8/2001	Chen	
5,666,157	A	9/1997	Aviv	6,297,844	B1	10/2001	Schatz et al.	
5,671,294	A	9/1997	Rogers et al.	6,304,669	B1	10/2001	Kaneko et al.	
5,684,715	A	11/1997	Palmer	6,307,885	B1	10/2001	Moon et al.	
5,696,503	A	12/1997	Nasburg	6,310,916	B1	10/2001	Han et al.	
5,696,551	A	12/1997	Katto	6,326,964	B1	12/2001	Snyder et al.	
5,708,767	A	1/1998	Yeo et al.	6,337,917	B1	1/2002	Onural et al.	
5,721,692	A	2/1998	Nagaya et al.	6,349,113	B1	2/2002	Mech et al.	
5,724,456	A	3/1998	Boyack et al.	6,351,265	B1	2/2002	Bulman	
5,764,306	A	6/1998	Steffano	6,351,492	B1	2/2002	Kim et al.	
5,768,413	A	6/1998	Levin et al.	6,360,234	B2	3/2002	Jain et al.	
5,774,569	A	6/1998	Waldenmaier	6,385,772	B1	5/2002	Courtney	
5,798,787	A	8/1998	Yamaguchi et al.	6,393,054	B1	5/2002	Altunbasak et al.	
5,801,943	A	9/1998	Nasburg	6,396,535	B1	5/2002	Waters	
5,802,203	A	9/1998	Black et al.	6,396,876	B1	5/2002	Babonneau et al.	
5,802,361	A	9/1998	Wang et al.	6,396,961	B1	5/2002	Wixson et al.	
5,844,603	A	12/1998	Ogata	6,404,455	B1	6/2002	Ito et al.	
5,850,352	A	12/1998	Moezzi et al.	6,404,925	B1	6/2002	Foote et al.	
5,860,086	A	1/1999	Crump et al.	6,408,293	B1	6/2002	Aggarwal et al.	
5,872,865	A	2/1999	Normile et al.	6,411,209	B1	6/2002	Lyons et al.	
5,875,304	A	2/1999	Winter et al.	6,411,724	B1	6/2002	Vaithilingam et al.	
5,875,305	A	2/1999	Winter et al.	6,424,370	B1	*	Courtney	348/143
5,886,701	A	3/1999	Chauvin et al.	6,437,819	B1	8/2002	Loveland	
5,912,980	A	6/1999	Hunke	6,441,734	B1	8/2002	Gutta et al.	
5,923,365	A	7/1999	Tamir et al.	6,456,320	B2	9/2002	Kuwano et al.	
5,926,210	A	7/1999	Hackett et al.	6,469,734	B1	10/2002	Nichani et al.	
5,937,092	A	8/1999	Wootton et al.	6,490,370	B1	12/2002	Krasinski et al.	
5,956,081	A	9/1999	Katz et al.	6,504,479	B1	1/2003	Lemons et al.	
5,959,690	A	9/1999	Toebes, VIII et al.	6,509,926	B1	1/2003	Mills et al.	
5,963,202	A	10/1999	Polish	6,515,615	B2	2/2003	Burchett et al.	
5,963,203	A	10/1999	Goldberg et al.	6,525,658	B2	2/2003	Streetman et al.	
5,969,755	A	10/1999	Courtney	6,525,663	B2	2/2003	Colmenarez et al.	
5,983,147	A	11/1999	Krumm	6,535,620	B2	3/2003	Wildes et al.	
5,983,251	A	11/1999	Martens et al.	6,539,396	B1	3/2003	Bowman-Amuah	
5,987,211	A	11/1999	Abecassis	6,542,840	B2	4/2003	Okamoto et al.	
5,990,955	A	11/1999	Koz	6,545,706	B1	4/2003	Edwards et al.	
5,999,189	A	12/1999	Kajiya et al.	6,546,115	B1	4/2003	Ito et al.	
5,999,877	A	12/1999	Takahashi et al.	6,546,135	B1	4/2003	Lin et al.	
				6,552,826	B2	4/2003	Adler et al.	
				6,570,496	B2	5/2003	Britton	
				6,570,608	B1	5/2003	Tseng	
				6,570,610	B1	5/2003	Kipust	

(56)

References Cited

U.S. PATENT DOCUMENTS

6,597,800	B1	7/2003	Murray et al.	7,650,058	B1	1/2010	Garoutte	
6,625,310	B2	9/2003	Lipton et al.	7,653,635	B1	1/2010	Paek et al.	
6,628,323	B1	9/2003	Wegmann	7,657,914	B2	2/2010	Whelan et al.	
6,628,835	B1	9/2003	Brill et al.	7,660,439	B1	2/2010	Lu et al.	
6,646,676	B1	11/2003	DaGraca et al.	7,683,929	B2	3/2010	Elazar et al.	
6,658,136	B1	12/2003	Brumitt	7,733,369	B2	6/2010	Yin et al.	
6,696,945	B1	2/2004	Venetianer et al.	7,734,724	B2	6/2010	Rezvani et al.	
6,697,103	B1	2/2004	Fernandez et al.	7,737,837	B2	6/2010	Donovan et al.	
6,697,104	B1	2/2004	Yakobi et al.	7,768,549	B2	8/2010	Cofer	
6,698,021	B1	2/2004	Amini et al.	7,774,326	B2	8/2010	Arrouye et al.	
6,707,486	B1	3/2004	Millet et al.	7,796,780	B2	9/2010	Lipton et al.	
6,707,852	B1	3/2004	Wang	7,822,224	B2	10/2010	Garoutte et al.	
6,721,454	B1	4/2004	Qian et al.	7,825,954	B2	11/2010	Zhang et al.	
6,724,915	B1	4/2004	Toklu et al.	7,826,066	B2	11/2010	Primot et al.	
6,727,938	B1	4/2004	Randall	7,868,912	B2	1/2011	Venetianer et al.	
6,738,424	B1	5/2004	Allmen et al.	7,884,849	B2	2/2011	Yin et al.	
6,741,977	B1	5/2004	Nagaya et al.	7,932,923	B2	4/2011	Lipton et al.	
6,754,367	B1	6/2004	Ito et al.	7,956,735	B2	6/2011	Jackson et al.	
6,757,328	B1	6/2004	Huang et al.	2001/0004739	A1	6/2001	Sekiguchi et al.	
6,792,319	B1	9/2004	Bilger	2001/0010542	A1	8/2001	Takagi et al.	
6,801,662	B1	10/2004	Owechko et al.	2001/0019357	A1	9/2001	Ito et al.	
6,807,361	B1	10/2004	Girgensohn et al.	2001/0033330	A1	10/2001	Garoutte	
6,816,184	B1	11/2004	Brill et al.	2001/0035907	A1	11/2001	Broemmelsiek	
6,816,186	B2	11/2004	Luke et al.	2002/0008758	A1	1/2002	Broemmelsiek et al.	
6,829,371	B1	12/2004	Nichani et al.	2002/0024446	A1	2/2002	Grech-Cini	
6,844,818	B2	1/2005	Grech-Cini et al.	2002/0048388	A1	4/2002	Hagihara et al.	
6,859,803	B2	2/2005	Dagtas et al.	2002/0051058	A1	5/2002	Ito et al.	
6,865,580	B1	3/2005	Bush	2002/0063154	A1	5/2002	Hoyos et al.	
6,924,801	B1	8/2005	Dorbie	2002/0082769	A1	6/2002	Church et al.	
6,930,689	B1	8/2005	Giacalone et al.	2002/0095490	A1	7/2002	Barker et al.	
6,940,397	B1	9/2005	Le Mire	2002/0135483	A1	9/2002	Merheim et al.	
6,940,998	B2	9/2005	Garoutte	2002/0141637	A1*	10/2002	Brodsky et al.	382/165
6,954,498	B1	10/2005	Lipton	2002/0150308	A1	10/2002	Nakamura	
6,954,859	B1	10/2005	Simerly et al.	2002/0159634	A1	10/2002	Lipton et al.	
6,963,658	B2	11/2005	Hagihara et al.	2002/0163521	A1	11/2002	Ellenby et al.	
6,970,083	B2	11/2005	Venetianer et al.	2002/0163577	A1	11/2002	Myers	
6,975,220	B1	12/2005	Foodman et al.	2002/0171546	A1	11/2002	Evans et al.	
6,975,346	B2	12/2005	Kumhyr	2003/0010345	A1	1/2003	Koblasz et al.	
6,985,620	B2	1/2006	Sawhney et al.	2003/0020808	A1	1/2003	Luke et al.	
6,987,451	B2	1/2006	McKeown et al.	2003/0025599	A1	2/2003	Monroe	
6,987,528	B1	1/2006	Nagahisa et al.	2003/0043160	A1	3/2003	Elfvig et al.	
6,987,883	B2	1/2006	Lipton et al.	2003/0051255	A1	3/2003	Bulman et al.	
7,023,469	B1	4/2006	Olson	2003/0053659	A1	3/2003	Pavlidis et al.	
7,035,430	B2	4/2006	Ito et al.	2003/0058111	A1	3/2003	Lee et al.	
7,082,209	B2	7/2006	Ito et al.	2003/0058340	A1	3/2003	Lin et al.	
7,110,569	B2	9/2006	Brodsky et al.	2003/0058341	A1	3/2003	Brodsky et al.	
7,146,286	B2	12/2006	Takeda et al.	2003/0085992	A1	5/2003	Arpa et al.	
7,167,519	B2	1/2007	Comanicu et al.	2003/0093260	A1	5/2003	Dagtas et al.	
7,167,575	B1	1/2007	Nichani et al.	2003/0126622	A1	7/2003	Cohen et al.	
7,184,777	B2	2/2007	Diener et al.	2003/0163289	A1	8/2003	Whelan et al.	
7,197,072	B1	3/2007	Hsu et al.	2003/0231769	A1	12/2003	Bolle et al.	
7,218,756	B2	5/2007	Garoutte	2004/0113933	A1	6/2004	Guler	
7,224,852	B2	5/2007	Lipton et al.	2004/0130620	A1*	7/2004	Buehler et al.	348/143
7,227,893	B1	6/2007	Srinivasa et al.	2004/0137915	A1	7/2004	Diener et al.	
7,283,034	B2	10/2007	Nakamura et al.	2004/0143602	A1	7/2004	Ruiz et al.	
7,308,443	B1	12/2007	Lee et al.	2004/0151374	A1	8/2004	Lipton et al.	
7,319,479	B1*	1/2008	Crabtree et al.	2004/0161133	A1	8/2004	Elazar et al.	
7,356,830	B1	4/2008	Dimitrova	2004/0225681	A1	11/2004	Chaney et al.	
7,358,976	B2	4/2008	Hampshire, II et al.	2004/0240542	A1	12/2004	Yeredor et al.	
7,373,395	B2	5/2008	Brailean et al.	2004/0240546	A1	12/2004	Wells	
7,400,344	B2	7/2008	Ito et al.	2005/0002561	A1	1/2005	Monachino et al.	
7,423,666	B2	9/2008	Sakakibara et al.	2005/0146605	A1	7/2005	Lipton et al.	
7,424,167	B1	9/2008	Chosak et al.	2005/0157169	A1	7/2005	Brodsky et al.	
7,436,887	B2	10/2008	Yeredor et al.	2005/0162515	A1	7/2005	Venetianer et al.	
7,440,589	B2	10/2008	Garoutte	2005/0168574	A1	8/2005	Lipton et al.	
7,447,331	B2	11/2008	Brown et al.	2005/0169367	A1	8/2005	Venetianer et al.	
7,468,662	B2	12/2008	Velipasalar et al.	2005/0198063	A1	9/2005	Thomas et al.	
7,487,072	B2	2/2009	Semple et al.	2005/0275549	A1	12/2005	Barclay et al.	
7,522,745	B2	4/2009	Grasso et al.	2006/0066722	A1	3/2006	Yin et al.	
7,595,815	B2	9/2009	Donovan et al.	2006/0117356	A1	6/2006	Jojic et al.	
7,602,413	B2	10/2009	Kondo et al.	2006/0200842	A1	9/2006	Chapman et al.	
7,613,324	B2	11/2009	Venetianer et al.	2006/0222209	A1	10/2006	Zhang et al.	
7,623,677	B2	11/2009	Girgensohn et al.	2006/0232673	A1	10/2006	Lipton et al.	
				2006/0268111	A1	11/2006	Zhang et al.	
				2006/0279630	A1	12/2006	Aggarwal et al.	
				2007/0002141	A1	1/2007	Lipton et al.	
				2007/0013776	A1	1/2007	Venetianer et al.	

(56)

References Cited

U.S. PATENT DOCUMENTS

2007/0122000 A1 5/2007 Venetianer et al.
 2007/0127774 A1 6/2007 Zhang et al.
 2007/0182818 A1 8/2007 Buehler
 2008/0292140 A1 11/2008 Morris et al.
 2008/0317286 A1 12/2008 Thorpe et al.
 2009/0244291 A1 10/2009 Saptharishi et al.
 2010/0020172 A1 1/2010 Mariadoss

FOREIGN PATENT DOCUMENTS

DE 10153484 A1 5/2003
 DE 10252731 A1 5/2004
 EP 0293189 11/1988
 EP 0893923 1/1999
 EP 0913799 A2 5/1999
 EP 0967584 A2 12/1999
 EP 0967584 A2 12/1999
 EP 1024666 8/2000
 EP 1120746 8/2001
 EP 1333682 8/2003
 EP 1916618 A1 4/2008
 FR 2944934 A1 10/2010
 GB 2337146 A 10/1999
 JP 01-244598 9/1989
 JP 03-242592 2/1990
 JP 1991-035399 2/1991
 JP 05-014891 1/1993
 JP 1993-284501 10/1993
 JP 1994-52311 2/1994
 JP 1994-76047 3/1994
 JP 07-160891 6/1995
 JP 1995-302328 11/1995
 JP 1996-171681 2/1996
 JP 1996-63599 3/1996
 JP 08-123935 5/1996
 JP 08-136251 5/1996
 JP 1996-136251 5/1996
 JP 08-272926 10/1996
 JP 09-050585 2/1997
 JP 09-130783 5/1997
 JP 09-252467 9/1997
 JP 09247654 9/1997
 JP 1997-265539 10/1997
 JP 09-330415 12/1997
 JP H10-048008 2/1998
 JP 10-116359 5/1998
 JP 1998-116359 5/1998
 JP 10-283584 10/1998
 JP H10-290449 10/1998
 JP 1999-15982 1/1999
 JP 11-177973 7/1999
 JP 11-203568 7/1999
 JP 1999-355759 12/1999
 JP 2000-175174 6/2000
 JP 11-009618 7/2000
 JP 11-009619 7/2000
 JP 2000-207664 7/2000
 JP 2000-207665 7/2000
 JP 2000-224542 8/2000
 JP 11-48585 9/2000
 JP 2000-253382 9/2000
 JP 11-88337 10/2000
 JP 2000-285223 10/2000
 JP 2000-287173 10/2000
 JP 2000-295600 10/2000
 JP 2000-339923 12/2000
 JP 2001-045465 2/2001
 JP 2001-145092 5/2001
 JP 2001-175868 6/2001
 JP 2001-189925 7/2001
 JP 2001-204007 7/2001
 JP 2001-266131 9/2001

KR 100248374 12/1999
 KR 102000026757 5/2000
 WO WO-9403014 2/1994
 WO WO 98/19450 5/1998
 WO WO 00/28498 5/2000
 WO WO 01/33503 5/2001
 WO WO 01/62005 8/2001
 WO WO 03/044727 5/2003
 WO WO 2004/006184 A2 1/2004
 WO WO 2004/047039 A1 6/2004
 WO WO 2008/054489 A2 5/2008
 WO WO 2009/120616 A1 10/2009
 WO WO 2010/076261 A1 7/2010
 WO WO 2011/036661 A1 3/2011

OTHER PUBLICATIONS

Ivanov Y et al., "Video Surveillance of Interactions," Visual Surveillance, 1999. Second IEEE Workshop on, (VS '99) Fort Collins, CO, USA, Jun. 26, 1999, Los Alamitos CA, USA, IEEE Computer Society US.
 Lipton et al.: "Objectvideo Forensics: Activity-Based Video Indexing and Retrieval for Physical Security Applications", IEE Intelligent Distributed Surveillance Systems, Feb. 23, 2004.
 Heartwell et al: "Critical Asset Protection, Perimeter Monitoring and Threat Detection using Automated Video Surveillance—A Technology Overview with Case Studies", Proceedings 36th Annual 2002 International Carnahan Conference on Security Technology, 2002.
 Ellen McCarthy "A Firm That Lets Guards Keep an Electronic Eye Open", Oct. 21, 2002.
 International Search Report for International Application No. PCT/US08/09073, dated Nov. 3, 2008.
 Written Opinion for International Patent Application No. PCT/US08/09073, dated Nov. 3, 2008.
 A. Lipton, H. Fujiyoshi and R.S. Patil, "Moving Target Classification and Tracking from Real-Time Video," Proceedings of IEEE WACV '98, Princeton, NJ, 1998, pp. 8-14.
 W.E.L. Grimson, et al., "Using Adaptive Tracking to Classify and Monitor Activities in a Site," CVPR, pp. 22-29, Jun. 1998.
 A.J. Lipton, H. Fujiyoshi, R.S. Patil, "Moving Target Classification and Tracking from Real-time Video," IUW, pp. 129-136, 1998.
 T. J. Olson and F. Z. Brill, "Moving Object Detection and Event Recognition Algorithm for Smart Cameras," IUW, pp. 159-175, May 1997.
 A. J. Lipton, "Local Application of Optic Flow to Analyse Rigid Versus Non-Rigid Motion," International Conference on Computer Vision, Corfu, Greece, Sep. 1999.
 F. Bartolini, V. Cappellini, and A. Mecocci, "Counting people getting in and out of a bus by real-time image-sequence processing," IVC, 12(1):36-41, Jan. 1994.
 M. Rossi and A. Bozzoli, "Tracking and counting moving people," ICIP94, pp. 212-216, 1994.
 C. R. Wren, A. Azarbayejani, T. Darrell, and A. Pentland, "Pfinder: Real-time tracking of the human body," Vismod, 1995.
 L. Khoudour, L. Duvieubourg, J. P. Deparis, "Real-Time Pedestrian Counting by Active Linear Cameras," JEL, 5(4):452-459, Oct. 1996.
 S. Ioffe, D. A. Forsyth, "Probabilistic Methods for Finding People," IJCV, 43(1):45-68, Jun. 2001.
 M. Isard and J. MacCormick, "BramBLE: A Bayesian Multiple-Blob Tracker," ICCV, 2001.
 D. M. Gavrilu, "The Visual Analysis of Human Movement: A Survey," CVIU, 73(1):82-98, Jan. 1999.
 Niels Haering and Niels da Vitoria Lobo, "Visual Event Detection," Video Computing Series, Editor Mubarak Shah, 2001.
 Collins, Lipton, Kanade, Fujiyoshi, Duggins, Tsin, Tolliver, Enomoto, and Hasegawa, "A System for Video Surveillance and Monitoring: VSAM Final Report," Technical Report CMU-RI-TR-00-12, Robotics Institute, Carnegie Mellon University, May 2000.
 C. R. Wren, A. Azarbayejani, T. Darrell, and A. P. Pentland. "Pfinder: Real-Time Tracking of the Human Body," PAMI, vol. 19, pp. 780-784, 1997.
 M. Allmen and C. Dyer, "Long—Range Spatiotemporal Motion

(56)

References Cited

OTHER PUBLICATIONS

- L. Wixson, "Detecting Salient Motion by Accumulating Directionally Consistent Flow", IEEE Trans. Pattern Anal. Mach. Intell., vol. 22, pp. 774-781, Aug. 2000.
- JP Office Action issued for JP 2003-546290 on Oct. 9, 2007, with an English translation.
- Jemez Technology Corp., Variant iD Web-Site, www.variantid.com, printed Aug. 25, 2003.
- L. Wixson et al., "Detecting Salient Motion by Accumulating Directionally-Consistent Flow," IEEE, 1999.
- J. P. DeParis et al., "A Device for Counting Passengers Making Use of Two Active Linear Cameras: Comparison of Algorithms," IEEE, pp. 1629-1634, 1996.
- Alan J. Lipton "Virtual Postman-An Illustrative Example of Virtual Video," International Journal of Robotics and Automation, vol. 15, No. 1, Jan. 2000, pp. 9-16.
- Alan J. Lipton, "Virtual Postman—Real Time, Interactive Virtual Video," IASTED Conference on Computer Graphics and Imaging (CGIM'99), Palm Springs, Oct. 25-27, 1999.
- H. Fujiyoshi and A. J. Lipton, "Real-time Human Motion Analysis by Image Skeletonization," *Proceedings of IEEE WACV'98*, Princeton, NJ, 1998, pp. 15-21.
- R. T. Collins, Y. Tsin, J. R. Miller, and A. J. Lipton "Using a DEM to Determine Geospatial Object Trajectories," CMU-RI-TR-98-19, 1998.
- International Search Report issued for PCT Application No. PCT/US06/45625, mailed on Sep. 24, 2007.
- Written Opinion of the International Searching Authority issued for PCT Application No. PCT/US06/45625, mailed on Sep. 24, 2007.
- International Search Report and Written Opinion in PCT/US06/02700.
- A. Selinger and L. Wixson, "Classifying Moving Objects as Rigid and Non-Rigid Without Correspondences," *Proceedings of DARPA Image Understanding Workshop*, Nov. 1, 1998, pp. 341-347.
- International Search Report issued for PCT Application No. PCT/US06/25196, mailed Jan. 16, 2008.
- Written Opinion issued for PCT Application No. PCT/US06/25196, mailed Jan. 16, 2008.
- Written Opinion of the International Searching Authority issued for PCT Application No. PCT/US06/012556, mailed on Feb. 12, 2008.
- International Search Report of the International Searching Authority issued for PCT Application No. PCT/US06/012556, mailed on Feb. 12, 2008.
- CN Office Action for CN 02822772.7 on Oct. 14, 2005 in English.
- Collins, et al. "A System for Video Surveillance and Monitoring". Carnegie Mellon University, 2000.
- Kanade, et al. "Advances in Cooperative Multi-Sensor Video Surveillance". Robotics Institute, Carnegie Mellon University.
- Lipton, et al. "Automated Video Protection, Monitoring & Detection". IEEE AESS Systems Magazine, May 2003.
- Cao, et al. "Automatic Geo-Registration for Port Surveillance". International Journal of Pattern Recognition and Artificial Intelligence, Nov. 19, 2008.
- Haering, et al. "A Semantic Event-Detection Approach and Its Application to Detecting Hunts in Wildlife Video". IEEE Transactions on Circuits and Systems for Video Technology, vol. 10, No. 6, Sep. 2000.
- Cao, et al. "Automatic Geo-Registration of Maritime Video Feeds". IEEE, 2008.
- Haering, et al. "Content-Based Access of Image and Video Libraries". Proceedings on IEEE Workshop, pp. 15-25, Jun. 20, 1997.
- Baker, et al. "Autonomous Vehicle Video Aided Navigation—Coupling INS and Video Approaches".
- Lipton, Alan. "Keynote: Intelligent Video as a Force Multiplier for Crime Detection and Prevention".
- Ali, et al. "Interactive Retrieval of Targets for Wide Area Surveillance". MM'10, Firenze, Italy, Oct. 2010.
- Rice, et al. "Maritime Surveillance in the Intracoastal Waterway using Networked Underwater Acoustic Sensors integrated with a Regional Heartwell, et al. "Critical Asset Protection, Perimeter Monitoring and Threat Detection using Automated Video Surveillance—A Technology Overview with Case Studies", IEEE, 2002.
- Choe, et al. "Image Transformation for Object Tracking in High-Resolution Video". IEEE, 2008.
- Deng, et al. "Fast Forensic Video Event Retrieval Using Geospatial Computing".
- Venetianer, et al. "Performance evaluation of an intelligent video surveillance system—A case study". Computer Vision and Image Understanding 114, pp. 1292-1302, 2010.
- Hakeem, et al. "Semantic Video Search using Natural Language Queries" MM'09, Beijing, China, Oct. 2009.
- Rasheed, et al. "Rapidly Deployable Video Analysis Sensor Units for Wide Area Surveillance".
- Haering, Niels. "What Would You Pay for Automated Video Analysis?". 2009 Advanced Video and Signal Based Surveillance. IEEE, 2009.
- Office Action of Nov. 25, 2011 in related EPO Application No. 06 749 276.9-1232.
- Econolite, "Autoscope Image Sensor—AIS-IV," pp. 1-2, 2011.
- Ghanem et al., Representation and Recognition of Events in Surveillance Video Using Petri Nets, Proceedings of the 2004 IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops, pp. 1-9, 2004.
- Computer & Information Systems Abstracts, Keeping an Eye Out, 2005.
- Computer & Information Systems Abstracts, ObjectVideo Extends its Capabilities for Border Applications as Part of Multi-Million Dollar Homeland Security Advanced Research Project Agency Grant, 2006.
- Computer & Information Systems Abstracts, QA: Security Grants Up for Grabs, 2004.
- CSA, Veni, Vidi, Vici Analytics: But Who Will Really Conquer?, 2007.
- Dialog, Ex FCC Chief Makes Cisco Board an Even Dozen, Mar. 26, 2007.
- Dialog, Iridium Names VP for Data Business, Jul. 9, 2001.
- Diamond Back, (2) Digest, Jan. 27, 2000.
- Elsevier Eng. Info. Inc., Threat Detection Expands Role, Jul. 20, 2006.
- Gale/ Cengage, Airport Selects ObjectVideo for Intrusion Detection, Jun. 29, 2005.
- Gale/ Cengage, Appian Names Novak Biddle and MapQuest Exec to Its Board, Oct. 23, 2008.
- Gale/ Cengage, Avinor Selects ESP Group and ObjectVideo for Surveillance at Norwegian Airports, May 5, 2008.
- Gale/ Cengage, Bosch Security Systems Utilizes ObjectVideo's Intelligent Video Surveillance Software, Apr. 6, 2005.
- Gale/ Cengage, Chubb Security Taps ObjectVideo as Approved Supplier, Jul. 8, 2005.
- Gale/ Cengage, Companies in the News Today: About Chubb Security, Jul. 8, 2005.
- Gale/ Cengage, Companies in the News Today: About ObjectVideo Inc., Jul. 8, 2005.
- Gale/ Cengage, comScore Names Kenneth Tarpey as CFO, Apr. 26, 2009.
- Gale/ Cengage, Cornet Offers iVDO SmartEdge Video Analytics for Its Ruggedized iVDO IP Encoders, May 4, 2008.
- Gale/ Cengage, CoVi Technologies Adds Digital Video Analytics to Analog Video Surveillance Camera, Sep. 30, 2007.
- Gale/ Cengage, Digiop Inks OEM Partnership with ObjectVideo, Apr. 30, 2008.
- Gale/ Cengage, Does the eye spy? Around-the-clock video surveillance is the Holy Grail of K-12 safety efforts. But it raises many questions, including whether or not the cameras are a wholly benign presence., Nov. 1, 2007.
- Gale/ Cengage, Fibridge's New HD, IP Camera Leverages Reference Design from TI and ZOT, Dec. 13, 2008.
- Gale/ Cengage, Former FCC Chairman Powell Joins ObjectVideo Board of Directors, Sep. 9, 2005.

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