US007990422B2

(12) **United States Patent**
Ahiska et al.

(10) **Patent No.: US 7,990,422 B2**
(45) **Date of Patent: Aug. 2, 2011**

(54) **AUTOMATICALLY EXPANDING THE ZOOM CAPABILITY OF A WIDE-ANGLE VIDEO CAMERA**

(75) Inventors: **Bartu Ahiska**, Guildford (GB); **Mark Kenneth Davey**, Bromley (GB); **Ahmet Enis Cetin**, Ankara (TR)

(73) Assignee: **Grandeye, Ltd.**, Guildford, Surrey (GB)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 691 days.

(21) Appl. No.: **11/184,720**

(22) Filed: **Jul. 19, 2005**

(65) **Prior Publication Data**

US 2006/0056056 A1 Mar. 16, 2006

Related U.S. Application Data

(60) Provisional application No. 60/589,104, filed on Jul. 19, 2004.

(51) **Int. Cl.**
H04N 5/225 (2006.01)
H04N 5/232 (2006.01)

(52) **U.S. Cl.** **348/218.1**; 348/211.3

(58) **Field of Classification Search** 348/218.1; 345/428

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,505,465	A	4/1970	Rees	
3,725,563	A	4/1973	Woycechowsky	
4,326,218	A	4/1982	Coutta et al.	
4,549,208	A	10/1985	Kamejima et al.	
4,667,236	A	5/1987	Dresdner	
4,728,839	A	3/1988	Coughlan et al.	
4,763,280	A	8/1988	Robinson et al.	
4,821,209	A	4/1989	Hempel et al.	
4,992,866	A	2/1991	Morgan	
5,027,287	A	6/1991	Artigalas et al.	
5,164,827	A *	11/1992	Paff	348/143
5,185,667	A	2/1993	Zimmermann	
5,212,547	A	5/1993	Otsuki	
5,311,305	A	5/1994	Mahadevan et al.	
5,313,306	A	5/1994	Kuban et al.	
5,321,776	A	6/1994	Shapiro	

(Continued)

FOREIGN PATENT DOCUMENTS

EP 1 341 383 A2 9/2003

(Continued)

OTHER PUBLICATIONS

Comaniciu, D., Ramesh, V., and Meer, P., "Real-Time Tracking of Non-Rigid Objects Using Mean-shift," IEEE Computer Vision and Pattern Recognition, vol. 1 II, 2000, pp. 142-149.

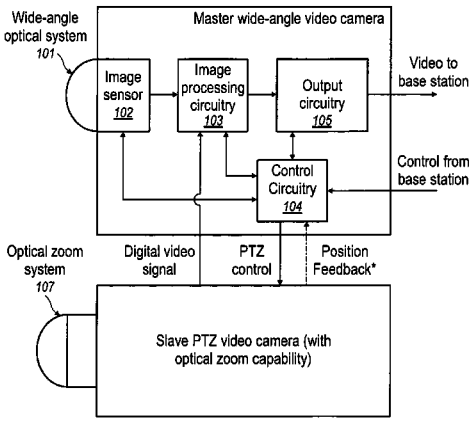
(Continued)

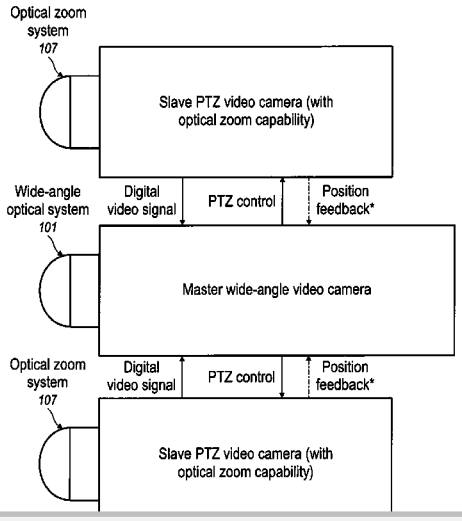
Primary Examiner — Jason Chan
Assistant Examiner — Joel Fosselman
(74) *Attorney, Agent, or Firm* — Robert Groover; Storm LLP

(57) **ABSTRACT**

A system for automatically expanding the zoom capability of a wide-angle video camera using images from multiple camera locations. One preferred embodiment achieves this using images from the wide-angle video camera that are analyzed to identify regions of interest (RoI). Pan-Tilt-Zoom (PTZ) controls are then sent to aim slave cameras toward the RoI. Processing circuitry is then used to replace the RoI from the wide-angle images with the higher-resolution images from one of the slave cameras. In addition, motion-detecting software can be utilized to automatically detect, track, and/or zoom in on moving objects.

6 Claims, 9 Drawing Sheets





U.S. PATENT DOCUMENTS

5,359,363	A	10/1994	Kuban et al.	
5,365,597	A	11/1994	Holeva	
5,384,588	A	1/1995	Martin et al.	
5,394,209	A	2/1995	Stiepel et al.	
5,396,284	A	3/1995	Freeman	
RE34,989	E	7/1995	Struhs et al.	
5,434,617	A	7/1995	Bianchi	
5,495,292	A	2/1996	Zhang	
5,530,650	A	6/1996	Biferno et al.	
5,539,483	A	7/1996	Nalwa	
5,563,650	A	10/1996	Poelstra	
5,589,901	A	12/1996	Means	
5,610,391	A	3/1997	Ringlien	
5,627,616	A	5/1997	Sergeant et al.	
5,654,750	A	8/1997	Weil et al.	
5,666,157	A	9/1997	Aviv	
5,684,937	A	11/1997	Oxaal	
6,049,281	A	4/2000	Osterwell	
6,147,709	A	11/2000	Martin et al.	
6,215,519	B1	4/2001	Nayar et al.	
6,243,099	B1	6/2001	Oxaal	
6,344,852	B1	2/2002	Zhu	
6,509,926	B1	1/2003	Mills et al.	
6,724,421	B1	4/2004	Glatt	
6,757,434	B2	6/2004	Miled et al.	
6,763,068	B2	7/2004	Oktem	
6,853,809	B2 *	2/2005	Pelletier	396/85
2002/0063711	A1 *	5/2002	Park et al.	345/428
2003/0128756	A1	7/2003	Oktem	
2003/0210329	A1 *	11/2003	Aagaard et al.	348/159
2005/0018045	A1 *	1/2005	Thomas et al.	348/157
2006/0197839	A1 *	9/2006	Senior et al.	348/169

FOREIGN PATENT DOCUMENTS

WO	WO 02/062056	A1	8/2002

OTHER PUBLICATIONS

Y. Yardimci, I. Yilmaz, A. E. Cetin, "Correlation Tracking Based on Wavelet Comain Information," Proceedings of SPIE vol. #5204, San Diego, Aug. 5-7, 2003.

A M. Bagci, Y. Yardimci, A. E. Cetin, "Moving Object Detection Using Adaptive Subband Decomposition and Franctional Lower-Order Statistics in Video Sequences," Signal Processing, 82 (12): 1941-1947, Dec. 2002.

C. Stauffer, W. Grimson, "Adaptive Background Mixture Models for Real-Time Tracking." Proc. IEEE CS Conf. on Computer Vision and Pattern Recognition, vol. 2, 1999, pp. 246-252.

"A System for Video Surveillance and Monitoring," in Proc. American Nuclear Society (ANS) Eighth International Topical Meeting on Robotics and Remote Systems, Pittsburgh, PA, Apr. 25-29, 1999, by Collins, Lipton and Kanade.

Aube, 12th International Conference on Automatic Fire Detection, 2001.

X. Zhou, R. Collins, T. Kanade, and P. Metes, "A Master-Slave System to Acquire Biometric Imagery of Humans at Distance", ACM International Workshop on Video Surveillance, Nov. 2003.

* cited by examiner

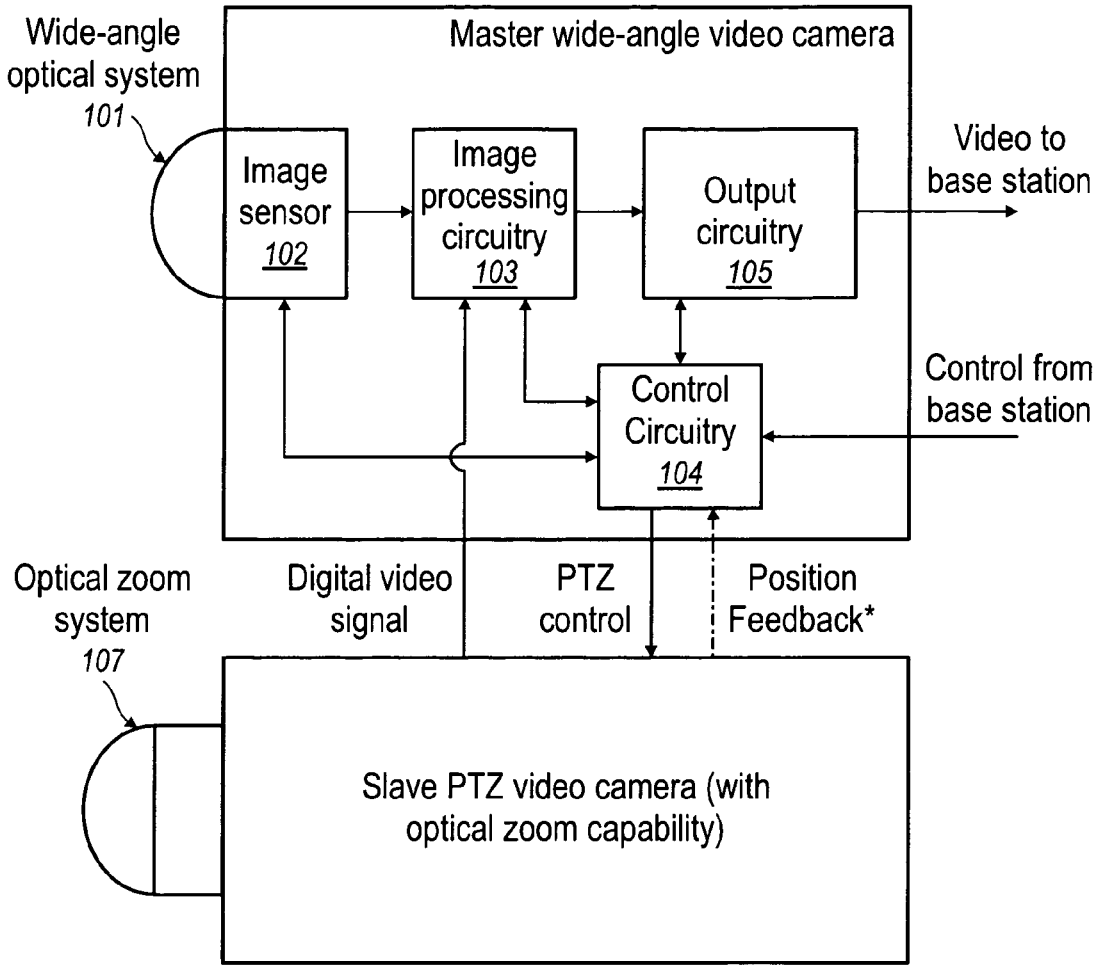


FIG. 1A

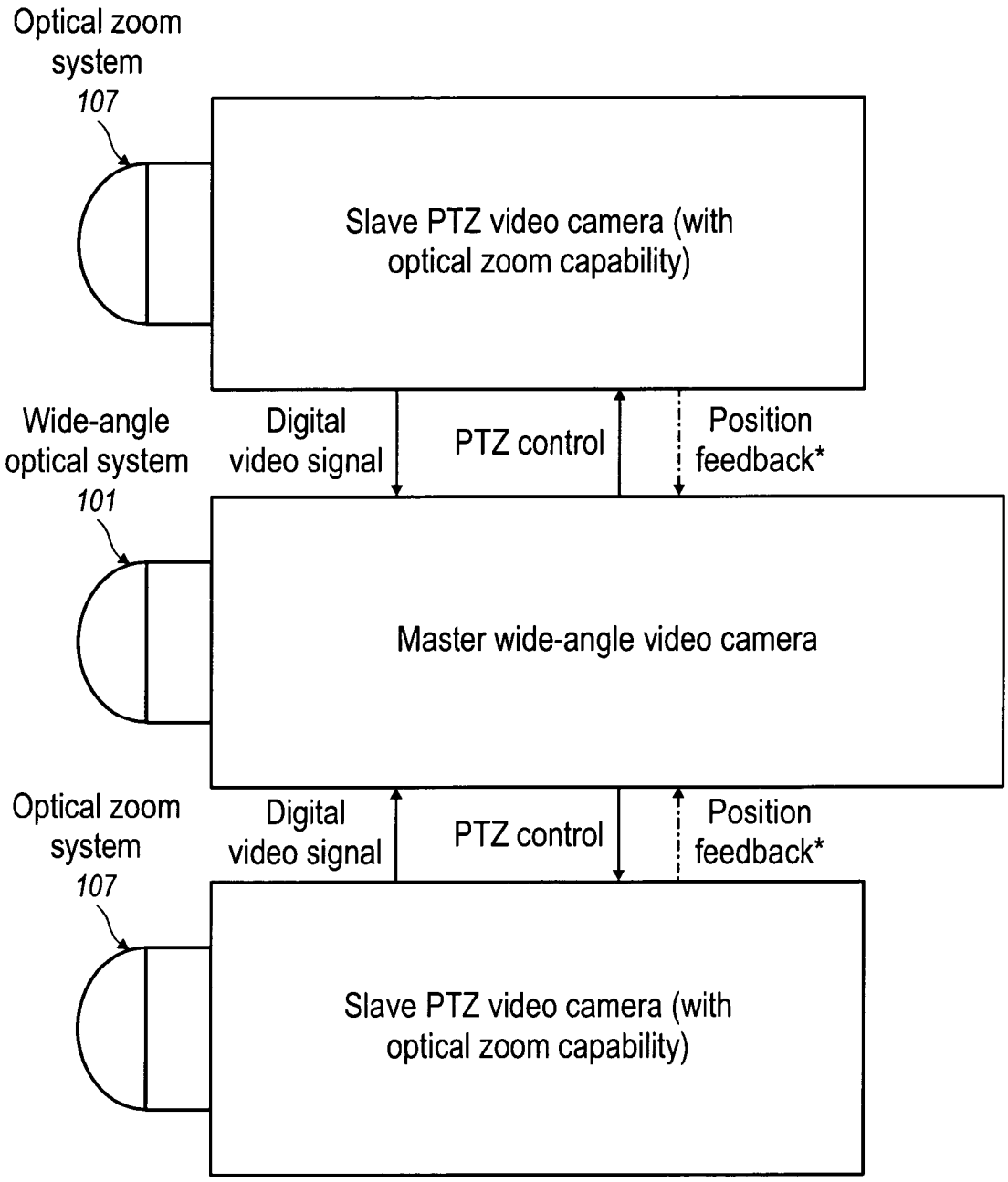


FIG. 1B

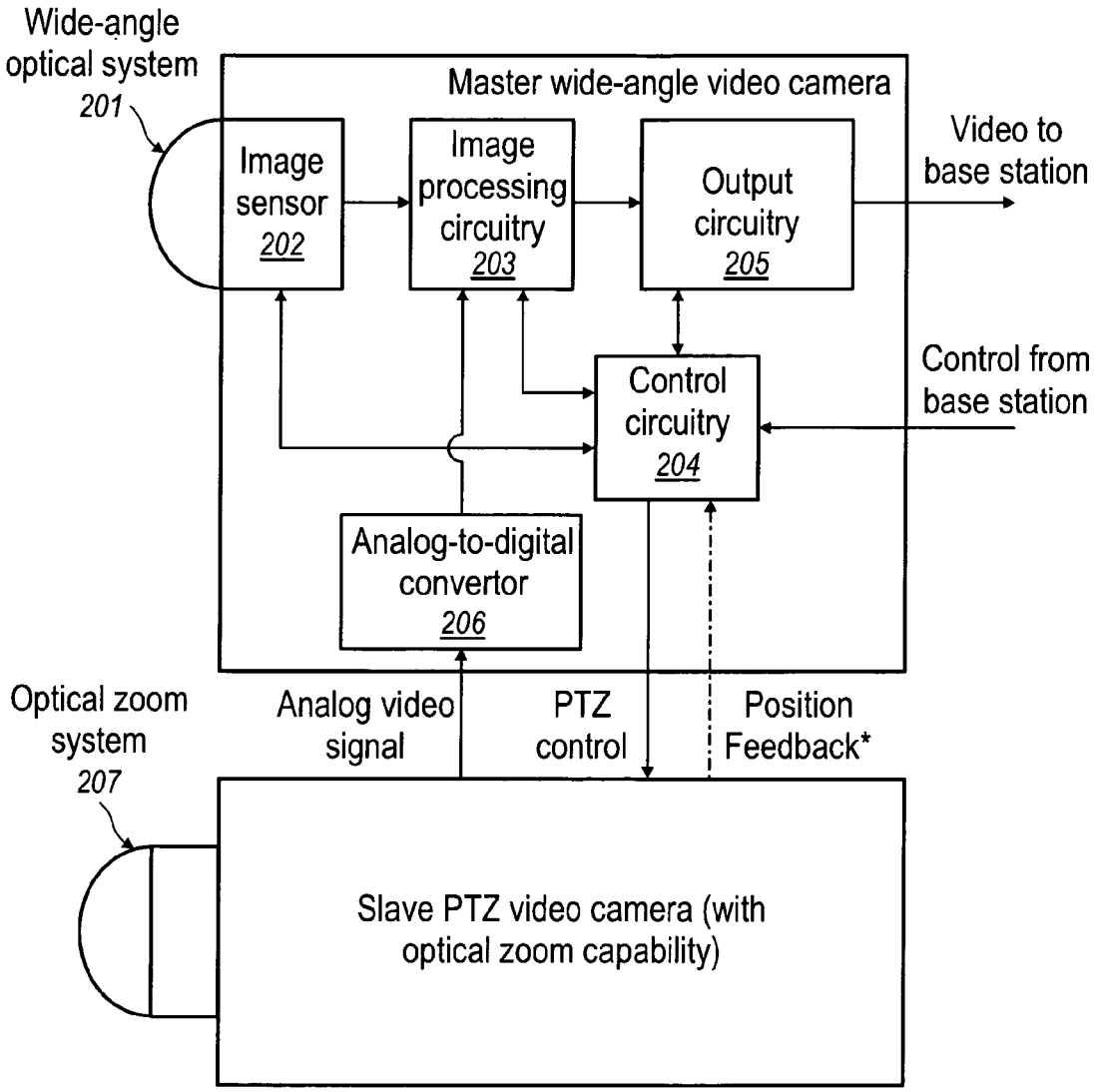


FIG. 2

DOCKET ALARM

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.