



US007158118B2

(12) **United States Patent  
Liberty**

(10) **Patent No.:** US 7,158,118 B2  
(45) **Date of Patent:** \*Jan. 2, 2007

(54) **3D POINTING DEVICES WITH  
ORIENTATION COMPENSATION AND  
IMPROVED USABILITY**

(75) Inventor: **Matthew G. Liberty**, Potomac, MD  
(US)

(73) Assignee: **Hillcrest Laboratories, Inc.**, Rockville,  
MD (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.

This patent is subject to a terminal dis-  
claimer.

(21) Appl. No.: **11/119,719**

(22) Filed: **May 2, 2005**

(65) **Prior Publication Data**

US 2005/0243062 A1 Nov. 3, 2005

**Related U.S. Application Data**

(60) Provisional application No. 60/641,410, filed on Jan.  
5, 2005, provisional application No. 60/566,444, filed  
on Apr. 30, 2004, provisional application No. 60/612,  
571, filed on Sep. 23, 2004.

(51) **Int. Cl.**  
**G09G 5/00** (2006.01)  
**G09G 5/08** (2006.01)

(52) **U.S. Cl.** ..... **345/158**; 345/156; 345/157;  
345/163

(58) **Field of Classification Search** ..... 345/156-169,  
345/173-179; 178/18.01-18.07, 19.01-19.06  
See application file for complete search history.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,787,051 A 11/1988 Olson

4,839,838 A	6/1989	LaBiche et al.	
5,045,843 A	9/1991	Hansen	
5,138,154 A	8/1992	Hotelling	
5,181,181 A *	1/1993	Glynn	702/141
5,359,348 A	10/1994	Pilcher et al.	
5,440,326 A	8/1995	Quinn	
5,506,605 A *	4/1996	Paley	345/163
5,698,784 A	12/1997	Hotelling et al.	
5,703,623 A	12/1997	Hall et al.	
5,825,350 A	10/1998	Case, Jr. et al.	
5,835,156 A	11/1998	Blonstein et al.	
5,898,421 A	4/1999	Quinn	
5,912,612 A	6/1999	DeVolpi	
5,955,988 A	9/1999	Blonstein et al.	
6,002,394 A	12/1999	Schein et al.	
6,016,144 A	1/2000	Blonstein et al.	
6,049,823 A	4/2000	Hwang	
6,115,028 A *	9/2000	Balakrishnan et al.	345/157
6,164,808 A *	12/2000	Shibata et al.	700/85

(Continued)

**OTHER PUBLICATIONS**

Navarrete, P., et al., "Eigensapce-based Recognition of Faces:  
Comparisons and a new Approach," Image Analysis and Processing,  
2001, pp. 1-6.

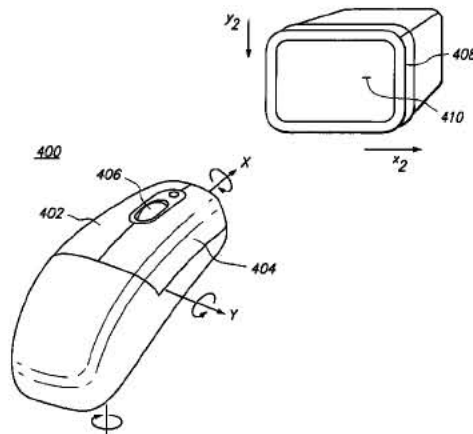
(Continued)

*Primary Examiner*—Vijay Shankar  
(74) *Attorney, Agent, or Firm*—Potomac Patent Group  
PLLC

(57) **ABSTRACT**

Systems and methods according to the present invention  
describe 3D pointing devices which enhance usability by  
transforming sensed motion data from a first frame of  
reference (e.g., the body of the 3D pointing device) into a  
second frame of reference (e.g., a user's frame of reference).  
One exemplary embodiment of the present invention  
removes effects associated with a tilt orientation in which the  
3D pointing device is held by a user.

**17 Claims, 9 Drawing Sheets**



U.S. PATENT DOCUMENTS

6,466,831	B1 *	10/2002	Shibata et al. ....	700/85
6,492,981	B1	12/2002	Stork et al.	
6,753,849	B1	6/2004	Curran et al.	
6,757,446	B1 *	6/2004	Li et al. ....	382/293
6,933,923	B1	8/2005	Feinstein	
6,990,639	B1	1/2006	Wilson	
6,998,966	B1	2/2006	Pedersen et al.	
2003/0107551	A1	6/2003	Dunker	
2004/0095317	A1	5/2004	Zhang et al.	
2004/0239626	A1	12/2004	Noguera	
2004/0268393	A1	12/2004	Hunleth et al.	
2005/0174324	A1	8/2005	Liberty et al.	
2005/0212767	A1	9/2005	Marvit et al.	
2005/0243061	A1	11/2005	Liberty et al.	
2005/0253806	A1	11/2005	Liberty et al.	
2006/0028446	A1	2/2006	Liberty et al.	

2006/0092133 A1\* 5/2006 Touma et al. .... 345/158

OTHER PUBLICATIONS

Jakubowski, J., et al., "Higher Order Statistics and Neural Network for Tremor Recognition," IEEE Transactions on Biomedical Engineering, vol. 49, No. 2, Feb. 2002, pp. 152-159.

Liu, C., et al., "Enhanced Fisher Linear Discriminant Models for Face Recognition," Proc. 14<sup>th</sup> International Conference on Pattern Recognition, Queensland, Australia, Aug. 17-20, 1998, pp. 1-5.

International Search Report for PCT/US05/15096, mailed May 16, 2006.

Written Opinion for PCT/US05/15096, mailed May 15, 2006.

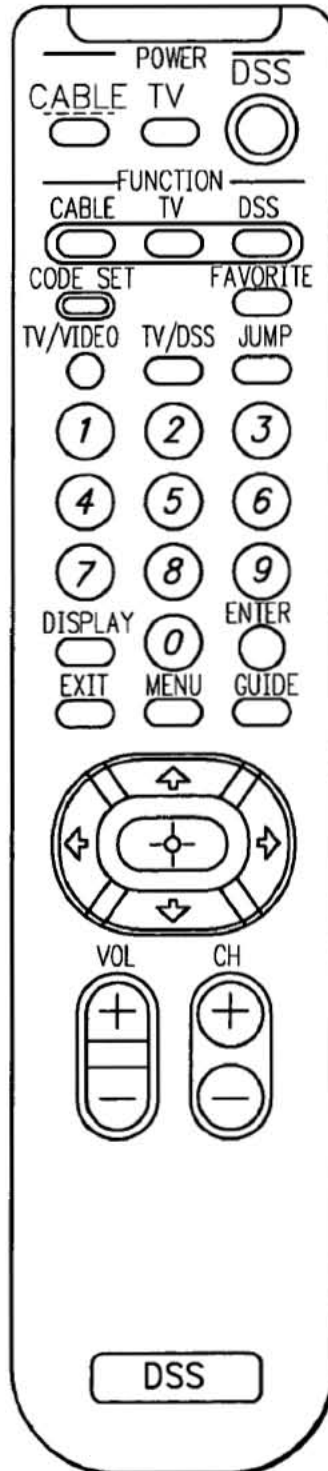
International Search Report for PCT/US04/35369, mailed May 11, 2006.

Written Opinion for PCT/US04/35369, mailed May 11, 2006.

Green, J., et al., "New iMEMS Angular-Rate-Sensing Gyroscope," Analog Dialogue, 37-03 (2003), pp. 1-4.

\* cited by examiner

**FIG. 1**  
(Prior Art)



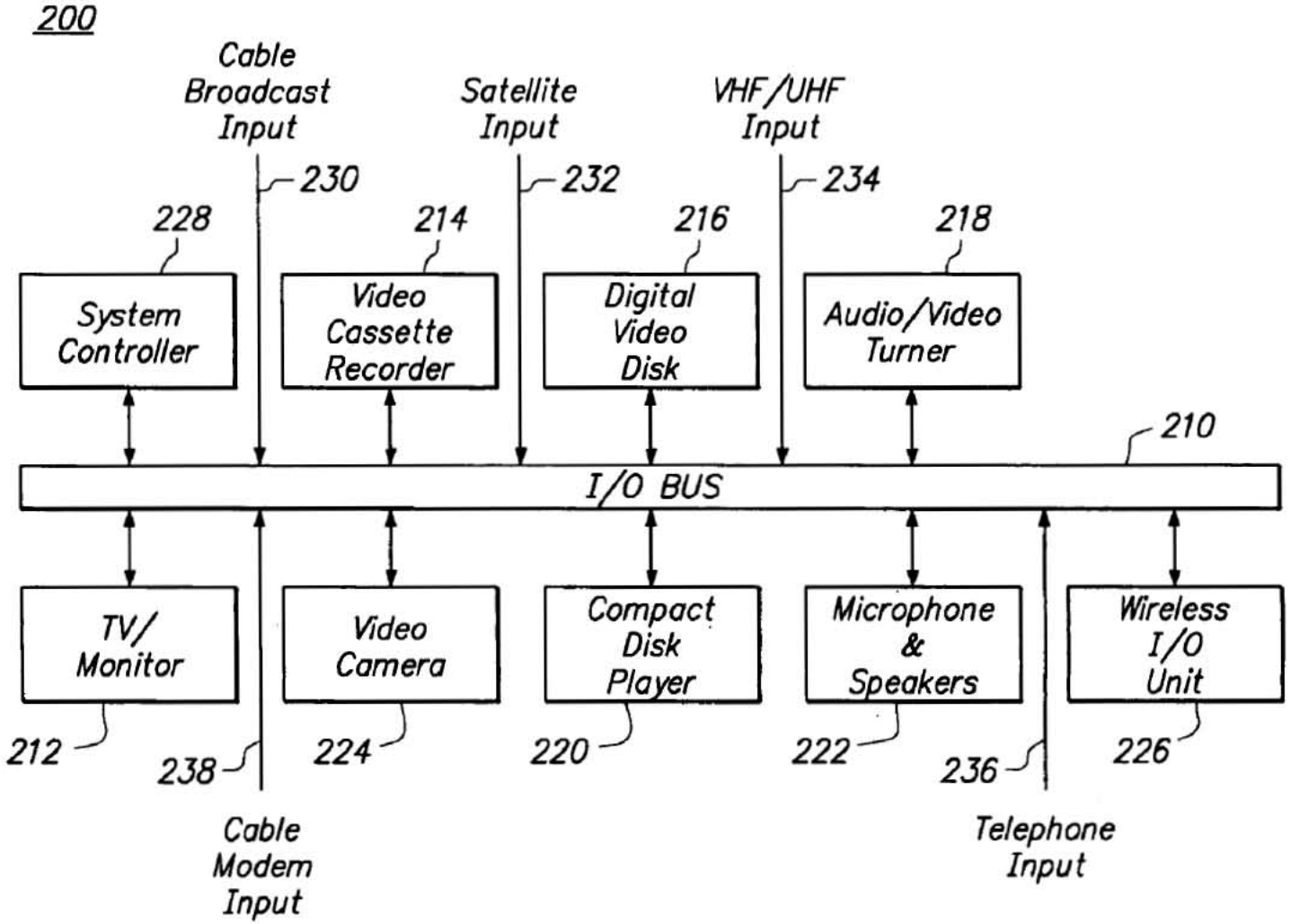
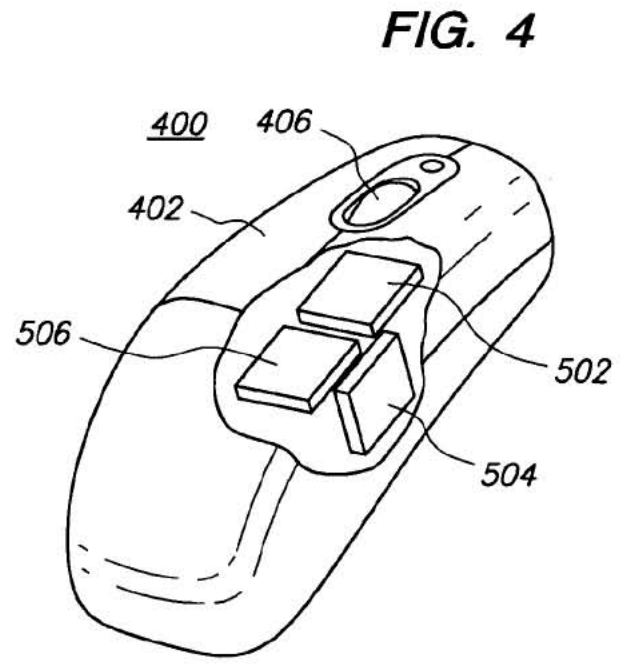
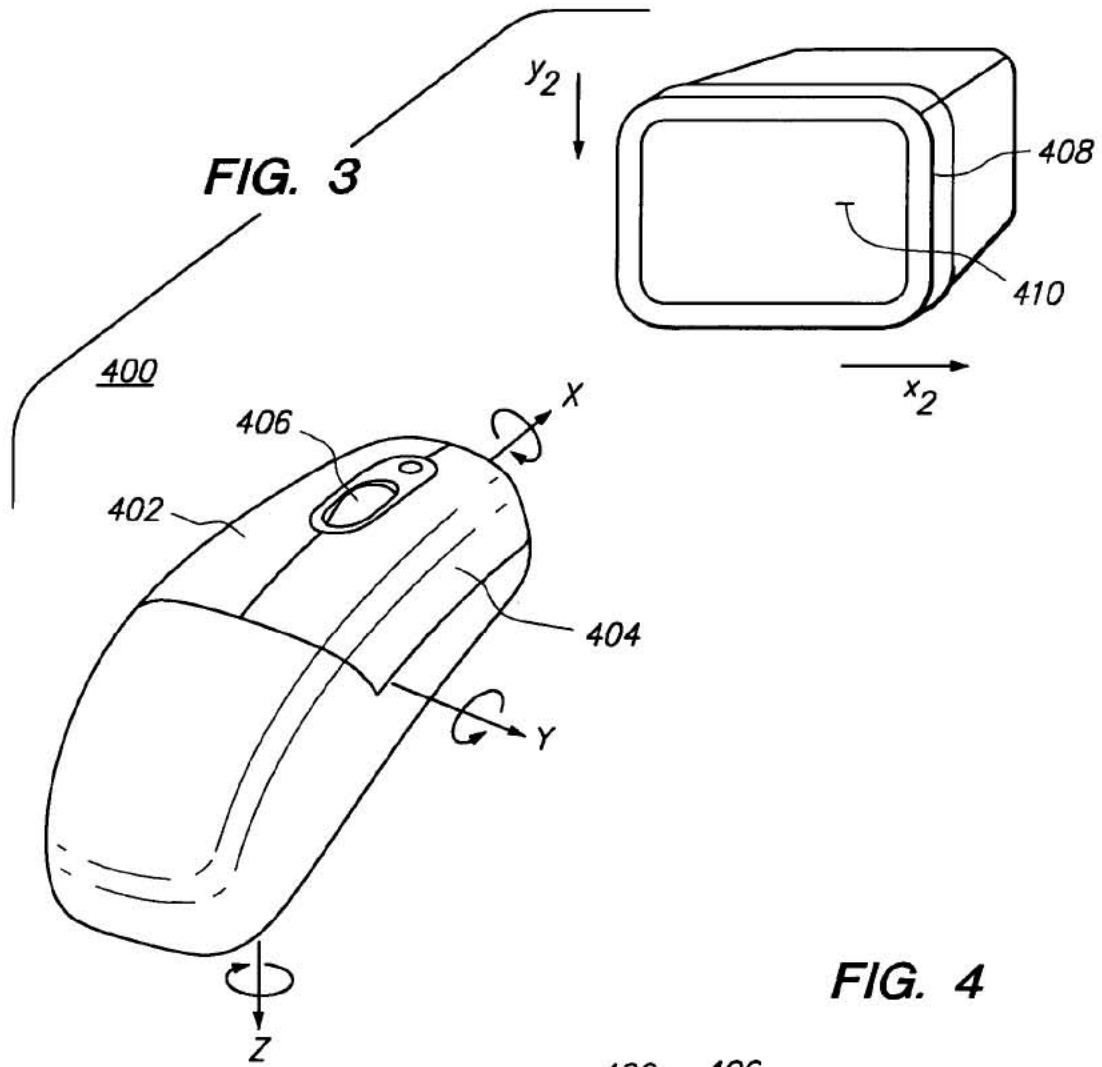


FIG. 2



# 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.