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Liberty

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

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This patent is subject to a terminal disclaimer.

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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.
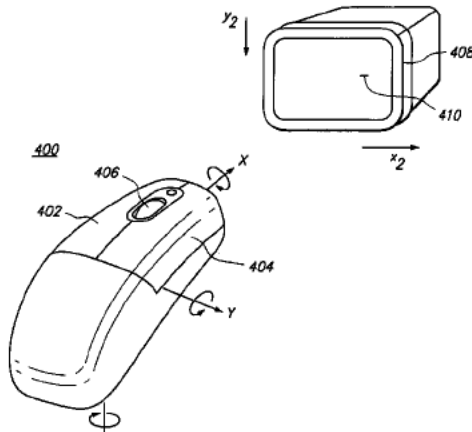
(Continued)

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(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. 14th 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.

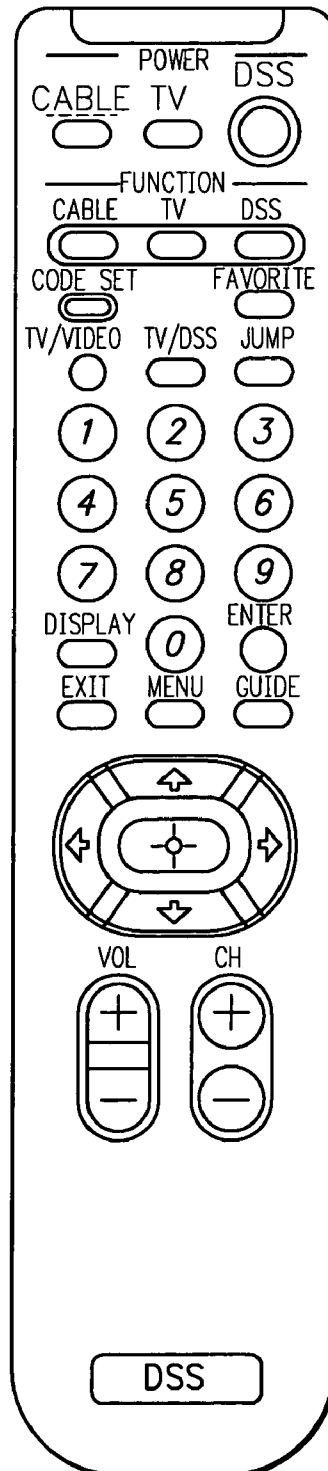Written Opinion for PCT/US05/15096, mailed May 15, 2006.

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

FIG. 3

y_2

408

410

x_2

400

406

402

X

404

Y

Z

FIG. 4

400   406

402

506

502

504

DOCKET ALARM
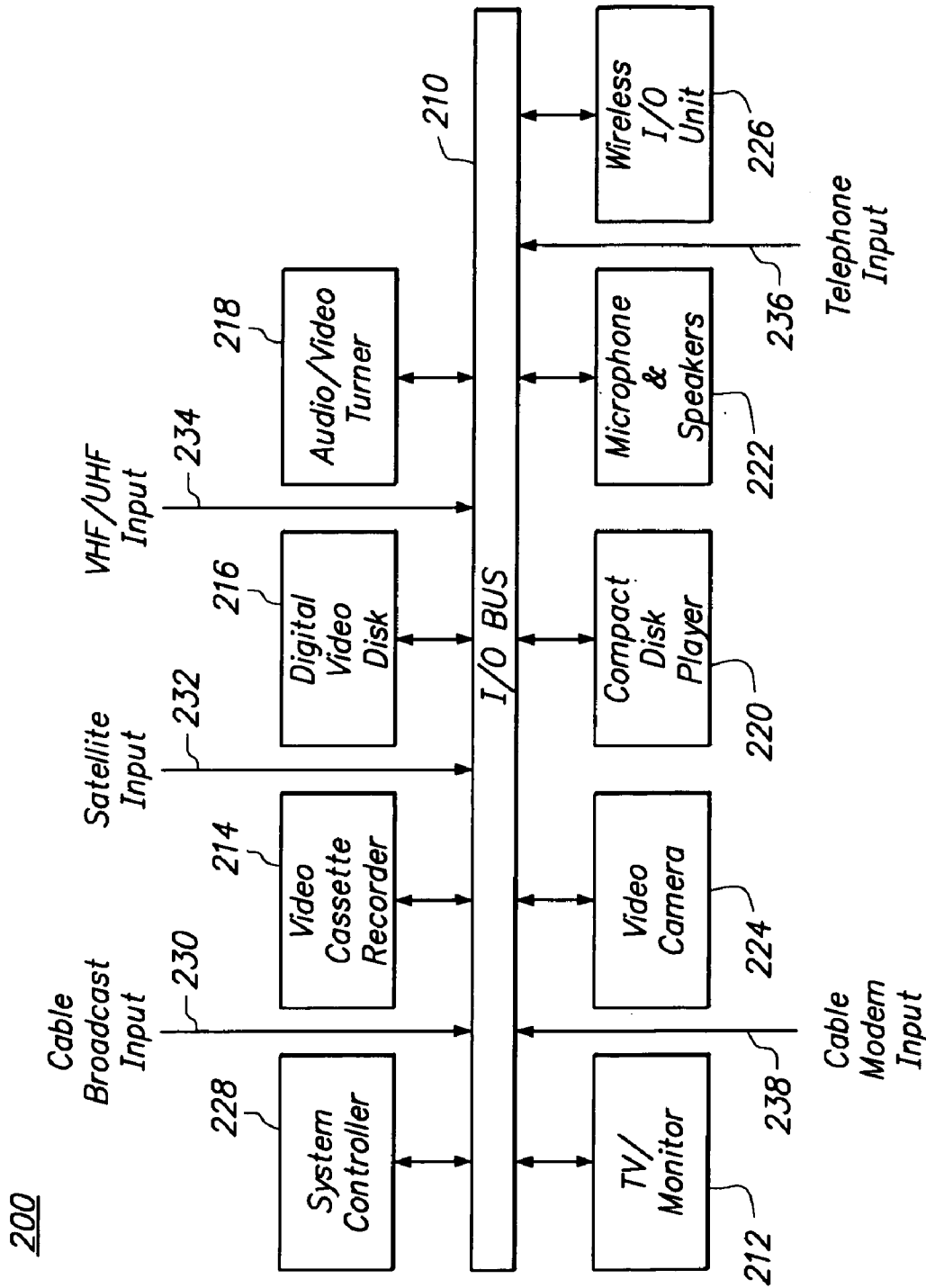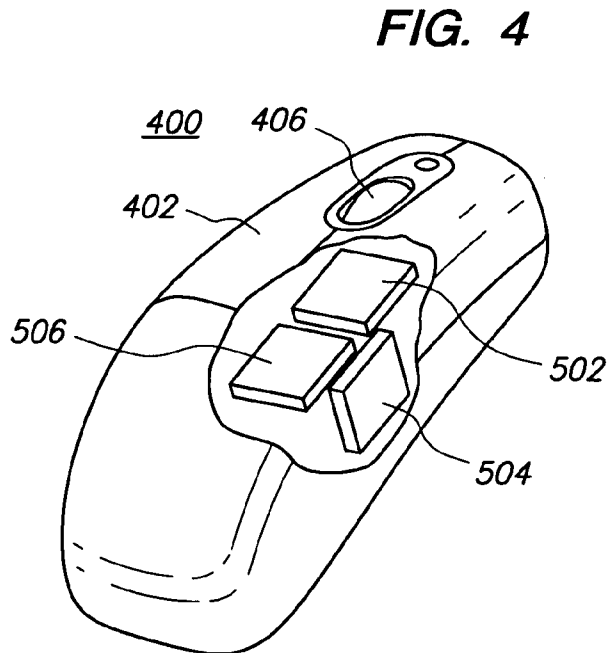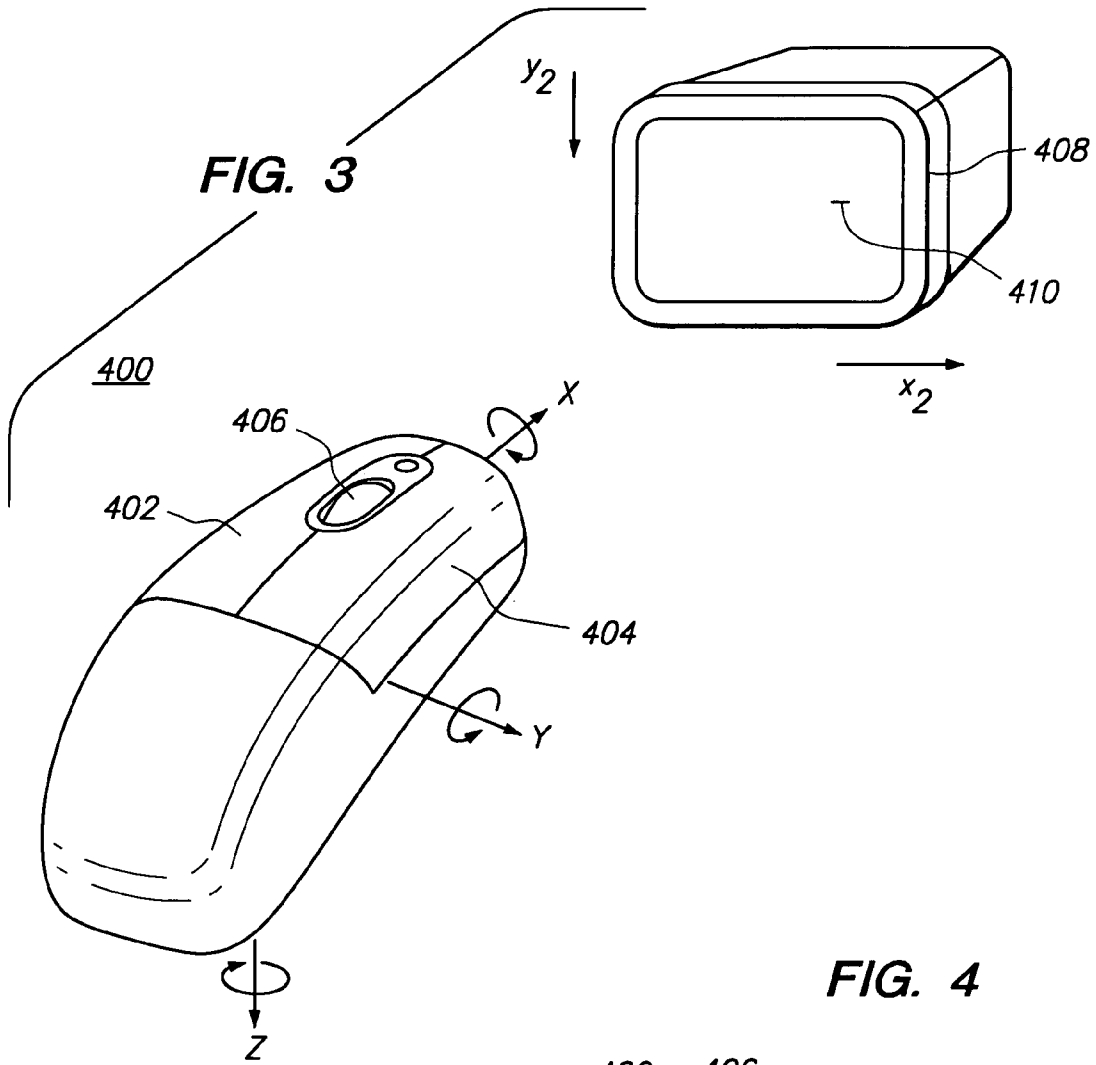
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