

<配布資料> 特許②公報フロントページ



US006088017A

**United States Patent** [19]  
**Tremblay et al.**

[11] **Patent Number:** **6,088,017**  
[45] **Date of Patent:** **Jul. 11, 2000**

[54] **TACTILE FEEDBACK MAN-MACHINE INTERFACE DEVICE**  
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**Mark H. Yim**, Palo Alto, both of Calif.  
[73] Assignee: **Virtual Technologies, Inc.**, Palo Alto, Calif.  
[21] Appl. No.: **09/066,608**  
[22] Filed: **Apr. 24, 1998**

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**Related U.S. Application Data**

[63] Continuation of application No. 08/565,102, Nov. 30, 1995, abandoned.  
[51] **Int. Cl.<sup>7</sup>** ..... **G09G 5/00**  
[52] **U.S. Cl.** ..... **345/156; 414/5**  
[58] **Field of Search** ..... 345/156, 158, 345/157, 145, 146; 414/2, 5, 1, 3, 4, 6, 7; 901/32-34

[57] **ABSTRACT**

A man-machine interface which provides tactile feedback to various sensing body parts is disclosed. The device employs one or more vibrotactile units, where each unit comprises a mass and a mass-moving actuator. As the mass is accelerated by the mass-moving actuator, the entire vibrotactile unit vibrates. Thus, the vibrotactile unit transmits a vibratory stimulus to the sensing body part to which it is affixed. The vibrotactile unit may be used in conjunction with a spatial placement sensing device which measures the spatial placement of a measured body part. A computing device uses the spatial placement of the measured body part to determine the desired vibratory stimulus to be provided by the vibrotactile unit. In this manner, the computing device may control the level of vibratory feedback perceived by the corresponding sensing body part in response to the motion of the measured body part. The sensing body part and the measured body part may be separate or the same body part.

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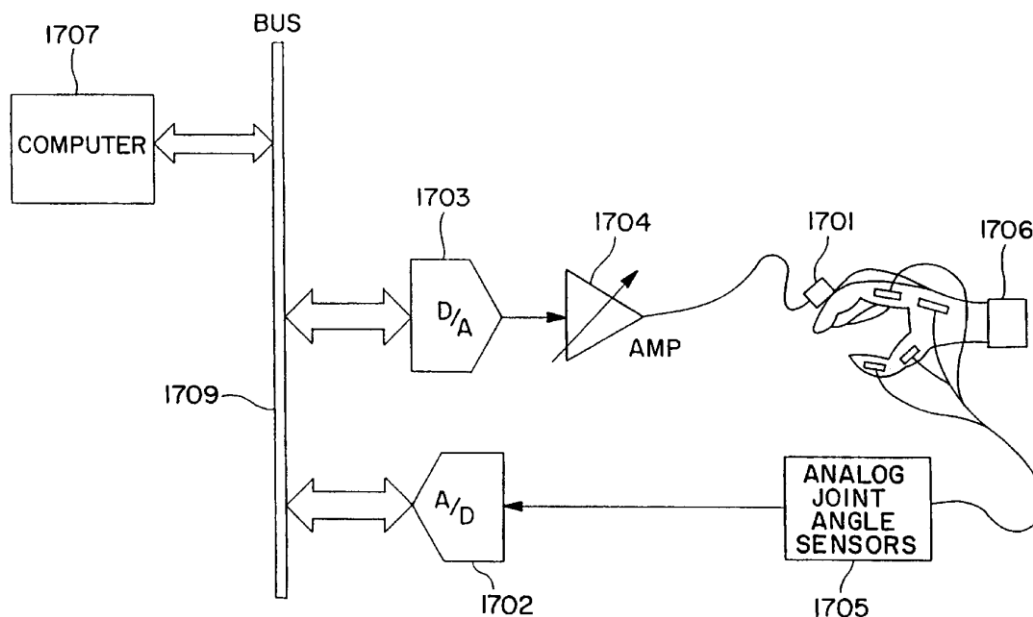
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**24 Claims, 20 Drawing Sheets**





US006275213B1

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

(10) **Patent No.:** **US 6,275,213 B1**  
(45) **Date of Patent:** **\*Aug. 14, 2001**

(54) **TACTILE FEEDBACK MAN-MACHINE  
INTERFACE DEVICE**

(75) Inventors: **Mark R. Tremblay**, Mountain View;  
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(\* ) 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.: **09/561,782**

(22) Filed: **May 1, 2000**

**Related U.S. Application Data**

(63) Continuation of application No. 09/066,608, filed on Apr.  
24, 1998, now Pat. No. 6,088,017, which is a continuation  
of application No. 08/565,102, filed on Nov. 30, 1995, now  
abandoned.

(51) **Int. Cl.**<sup>7</sup> ..... **G09G 5/00**

(52) **U.S. Cl.** ..... **345/156; 414/5**

(58) **Field of Search** ..... 345/145, 146,  
345/156, 158, 157; 414/1-7; 901/32-34

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(57) **ABSTRACT**

A man-machine interface which provides tactile feedback to  
various sensing body parts is disclosed. The device employs  
one or more vibrotactile units, where each unit comprises a  
mass and a mass-moving actuator. As the mass is accelerated  
by the mass-moving actuator, the entire vibrotactile unit  
vibrates. Thus, the vibrotactile unit transmits a vibratory  
stimulus to the sensing body part to which it is affixed. The  
vibrotactile unit may be used in conjunction with a spatial  
placement sensing device which measures the spatial place-  
ment of a measured body part. A computing device uses the  
spatial placement of the measured body part to determine the  
desired vibratory stimulus to be provided by the vibrotactile  
unit. In this manner, the computing device may control the  
level of vibratory feedback perceived by the corresponding  
sensing body part in response to the motion of the measured  
body part. The sensing body part and the measured body part  
may be separate or the same body part.

**60 Claims, 20 Drawing Sheets**

