Exhibit 3

UNITED STATES DEPARTMENT OF COMMERC
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER
OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

RETENTION LABEL
DO NOT DESTROY

11/12/97

Brad Armstrong
848 Inyo Street
Chico,CA 95928

Disclosure Document No. : 381081
Patent Application No. : 08/677,378
Group Art Unit : 2609

Copy

Dear : Mr. Brad Armstrong

Per your request, a retention has been applied to the above Disclosure Document referenced in the above patent application. A copy of this letter will be maintained in the file of the patent application, and the Disclosure Document will be forwarded to the Group Art Unit.

Sincerely,

Crystal Hammond
Customer Service Center
Initial Patent Examination Division

10 577 Cares

Commission of Patent and Trademarks
Washington, DC 20231
BOX DD

DISCLOSURE DOCUMENT
NO 381081

MAIL ROOM NOV 22 1995 PAT. & TRADEMARK OFF.

Disclosure Document

Name and address of the Inventor:
Brad A. Armstrong
848 Inyo Street
Chico, CA 95928

Dear Sir:

The undersigned, being the Inventor of the disclosed invention, respectfully requests that this Disclosure Document be accepted and retained for at least two years under the Disclosure Document Program, thank you.

The title of the Invention is:
MULTI-AXIS GRAPHICS CONTROLLERS AND COMPONENTS THEREFOR

Respectfully,

Signed Brad Armstrong Date: November 22 1995
Brad A. Armstrong, Inventor

Enclosures: Disclosure Document filing fee $10.00
Written description of the Invention
17 pages written — Drawings of the Invention
58 figures — Photographs of the Inventions
16 photos — Duplicate of this signed cover letter
Postage and addressed return envelope

CERTIFICATE OF EXPRESS MAILING

Commissioner of Patents and Trademarks
Washington, D. C. 20231
I hereby certify that this Disclosure Document is being deposited with the United States Postal Service as EXPRESS MAIL, article number EG313952652US with sufficient postage paid in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D. C. 20231, on this date: Nov. 22, 1995

Signature of one making deposit: Brad Armstrong
Brad A. Armstrong, Inventor/Applicant

120 DB 01/30/96 ARMSTRONG B 3 577 10.00 CK

Disclosure of Inventions

by Brad Armstrong

November 22, 1995

The following discriptions, figures, and photographs show inventive material related to multiple axes controllers. It is intended to file patent applications immediately concerning the following advances in the art:

1. Mechanical-Pure resolution (sensors individually representative of axes and mechanically resolved without compromise);

2. Sheet sensor structural means;

3. Threshold Tactile (turn on/off) feedback for 3+ degrees of freedom controllers;

4. Keyboard integration for 3+ degrees of freedom controllers;

5. Remote Control integration for 3+ degrees of freedom controllers;

6. Tactile-Pressure Sensor structures;

7. Super Rugged 4+ degrees of freedom controllers for arcade environments, etc.

Please find following some written description of 17 pages (not including many utility and process claims still to be drafted, and figures numbering 58 drawings, and photographs of embodiments reduced to practice numbering 16 photographs.

Thank You,

Brad Armstrong
sole inventor

1. Field of the Invention:

This invention relates to control devices having multiple degrees of freedom to be operated by the human hand. More specifically, the present invention in one form is a six degree of freedom input device for controlling or manipulating graphic images such as are displayed by a computer or television display, a head mount display or any display capable of being viewed or perceived as being viewed by a human.

2. Description of the Prior Art:

Although there are hand manipulated multi-axes and six degree of freedom controllers taught in the prior art, none are structured the same as the present invention, and none offer all of the advantages provided by the present invention due to the substantial structural differences.

In prior art related multi-axes controllers, whether 3, 4, 5 or 6 degrees of freedom, shortcomings exist which the present invention overcomes. Although all of the prior art devices do not include all of the shortcomings to be described, all of the related prior art devices do include one or more of the following substantial problems. One common and substantial problem is cost of manufacture, and this is particularly true for 6 degree of freedom controllers. It is realized that "low-cost" is a somewhat relative term, however the vast majority of consumers do not define controllers having retail sales prices ranging from $180 U.S. dollars up to several thousand U.S dollars as inexpensive or low-cost, and current manufacturing cost is, in my opinion, the single greatest force depriving society of low-cost 6 DOF controllers. To society at large, the truly useful 6 DOF controller will be, I believe, one having superb function and feel, with a very low retail cost to the end user. Another factor, and there are certainly many factors effecting cost of manufacture, is the lack of choice in useful sensors which may be utilized. Sensors of differing types vary widely in cost to the manufacturer, and many related prior art devices appear to be structured in a manner which makes them sensor-type dependant, which clearly has its disadvantages. Yet another factor dramatically effecting cost of manufacture is manual labor content of assembly, and soldering of wiring, etc. All known prior art sensor arrangements, location and orientation of the necessary plurality of sensors, appear to require the labor intensive use of individually insulated conductors (wires) which must be individually stripped, tinned, aligned, connected and then soldered to the sensors and associated circuitry. In most all cases it is highly desirable to reduce labor costs as much as possible since the single largest cost component in many manufactured items is commonly believed to be labor costs. For any controller such as a 6 DOF controller to be truly useful to society, it must be affordable for the common user to purchase.

Another common and substantial problem, and this shortcoming is particularly evident to the user in controllers providing 4 to 6 degrees of freedom, is the lack of definite and positive feedback (other than visual graphical feedback) for alerting the user as to when the controller has translated a hand input into an information output. Since a single 6 DOF controller has multiple sensors and so many axes of input interpretation, absent positive sensor actuation feedback, there exist difficulties of operation and a significant learning curve for a new user of such a device. In my opinion, even an experienced user of such a device would be appreciative of positive sensor actuation feedback.

Another common and substantial shortcoming in the related prior art is the lack of structuring for "pure- separate" interpretation, meaning straight linear hand input from a user's hand to the handle should cause the handle to move in a straight linear motion, with not even a small or significant degree of arcing or rotation of the handle. Pure-separate interpretation is also desirable for rotation inputs as will become apparent upon further reading.

Another common and substantial problem in some related prior art devices exists in structuring requiring complex and un-intuitive hand manipulations by the user. Such devices require the user to perform combined hand and finger (or thumb) manipulations to achieve a desired input. I believe ideal structuring of a controller allows manipulation of a single handle or like member in all six degrees of freedom along and about axes intersecting at a common point approximately central of the handle.

Another common and substantial problem, for a number of reasons, is the lack of mechanical resolution of all possible inputs of the handle into six individual mechanical bi-directional motions each independent of one another and respectively representing handle input along and about three mutually perpendicular axes. The lack of such structuring demands: electronic resolution, thus complex circuitry which increases the cost of manufacture; hand wiring, thus more labor increasing the cost of manufacture; and non-axial return-to-center resiliency, thus prohibiting a satisfactory degree of feedback indicating significant input has been made to control graphics along or about a given axis. Illustrating these problems, a specific prior art device described in U.S.

Patent 4,811,608 issued March 14, 1989 to J. A. Hilton for "Force and Torque Converter". The Hilton device exemplifies the lack of resolution of inputs of the handle into six individual mechanical bi-directional motions. This results in the Hilton device not being able to associate individual sensors and feedback structuring along and about each of the commonly recognized three mutually perpendicular axes.

Other closely related prior art devices of which I am aware, and which exemplify the above discussed shortcomings are described below.

U.S. Patent 4,555,960 issued Dec. 3, 1985 to M. King shows a 6 degree of freedom hand controller exemplifying the lack of "pure separate" interpretations for linear hand input. King's handle moves in a rotational arc when the user's intent is a purely linear input. See King column 4, line 13 - 18. In the King device, this is brought about by a "tilting" shaft 17 supporting the ratable handle. The shaft of King significantly tilts such that absent its tilting, there would be no ability to sense two of the three axes in regards to linear movement or force. Thus, pure-separate interpretation does not exist in the King device. King's controller also appears to be very costly to manufacture, having a large number of arms, bearings, gimbals, cams and connectors, etc., all of which apparently must be hand assembled, and sensors in an arrangement which apparently must be hand wired. Thus, again prohibiting truly low-cost manufacture.

A Great Britain patent application, published 08/07/91, application number GB 2 240 614 A, the applicants being U. A. Dzholdasbekov et al describes a control device capable of up to six axes of input. The Dzholdasbekov et al device exemplifies many problems common to the prior art, such as: lack of positive alerting as to when an input related to a particular axis has been activated; lack of resiliency for providing return-to-center function of the device and force feedback to the user; lack of suitable structuring lending itself to sensor arrangements for eliminating costly hand wiring; and lack of incorporation of all input manipulations into a single operable member (handle). On this last point, the Dzholdasbekov device is structured with two operable members: a rotatable handle and a rotatable thumb wheel, thus requiring complex and often difficult hand manipulations by the user. The user must combine separate hand and finger (or thumb) manipulations to achieve many commonly desired inputs. This may involve the user having to grasp and rotate the handle while simultaneously the handle is being moved linearly, and commonly at the same time having to operate a separate thumb wheel. Input of this type might be mastered with significant practice, but it is desirable to eliminate such complex requirements for the user. I believe, the ideal arrangement allows manipulation of a single handle or like member in all six degrees of freedom along and about axes intersecting at a common point approximately central within the handle. The Dzholdasbekov device also has structuring of sensors which appears to require hand wiring of each individual sensor, thus not allowing for low-cost manufacture.

Other problems associated with related prior art devices include: lack of low profile structuring for integration into computer keyboards and other devices, and ergonomic integration of active tactile feedback (electro-mechanical);

and lack of proper sensor arrangement and circuity for the ready low-cost integration of a multi- axes device into a computer keyboard or hand held remote control device, etc., as will become fully appreciated with further reading.

The above is not an exhaustive listing of shortcomings in the related prior art, nor is it an exhaustive listing of related prior art, but is of the most similar known prior art to the present invention. The above specifically mentioned prior art exemplifies common problems overcome by the present invention. For the sake of briefness, all prior art known to me having the same problem or problems as mentioned above have not been specifically addressed, however, some other related prior art known to me which may be of interest to the reader include U.S. patents: 3,296,882; 3,693,425; 3,771,037; 4,099,409; 4,369,663; 4,420,808; 4,935,728; 4,962,448; 5,128,671; 5,142,931, and 5,252,952.

Therefore, in review of the above mentioned problems embodied in the prior art, there clearly exists a need for further advancement and improvements in the field of multiple axes controllers, especially so regarding controllers for manipulating graphical images through a computer display device, future television screen or any display.

SUMMARY OF THE INVENTION

The following summary and detailed description is of best modes and preferred structures for carrying out the invention, and although there are clearly changes which could be made to that which is specifically herein described and shown in the included drawings, for the sake of briefness of this disclosure, all of these changes which fall within the true scope of the present invention have not herein been detailed.

In order for a user to better manipulate objects and/or navigate a viewpoint within a three-dimensional (3D) graphics environment or display, I have developed an improved hand manipulated multiple axes controller, preferably a six degree of freedom (henceforth "6 DOF") controller for use with a computer or computerized television or the like. The controller provides structuring for converting full 6 DOF operational input provided by a human hand into information states or electrical outputs useful either directly or indirectly for controlling or assisting in controlling graphic images.

The controller establishes readable moment related information states representing operation of a handle (hand manipulable member) along or about three mutually perpendicular axes preferably intersecting one another at a common point proximal to a center of the handle. The three mutually perpendicular axes are commonly referred to in the prior art as x, y and z, or yaw, pitch and roll, and because of varied different interpretations of the relative orientations of those terms, I herein refer to a generic first, second and third axes all mutually perpendicular to one another without regard to prior interpretations of orientation.

For the purpose of this specification and claims, the term "along" connotes linear movement, position or force on or parallel to an axis or combination of axes, and the term "about" connotes rotational movement, position or force (torque) orientation relative to an axis or combination of axes.

The present preferred 3D graphics controller is a hand-operated 6 DOF controller for converting human hand input manipulations into information states usefully representative of the input manipulations.

A preferred structure of the controller includes a housing, a carriage supported for allowing linear movement thereof, a non-tiltable shaft engaged with the carriage, and an exposed handle on the shaft, the handle being movable along and about all combinations of the three axes, thus providing interpretation of 6 DOF.

The controller preferably includes twelve sensors or six pairs of sensors for sensing linear and rotational inputs describing operation of the handle relative to any substantially stationary reference object such as the housing. Preferably each sensor has an associated return- to-center resiliency, and sensor-actuation passive feedback to be felt by the user's hand or heard by the user, or both. The sensor-actuation feedback is for transmitting detectable feedback to a user when the handle is operated sufficiently to actuate any of the sensors so that the user is alerted to the fact he or she has actuated a sensor. The sensor-actuation feedback includes a force feedback threshold which when the threshold is reached, the force feedback rapidly declines, which is felt by the user's hand and naturally understood by the user that a sensor has been actuated. The feedback can also be audible, as in a click-type sound. The rapid decline of the force feedback is readily detectable by the user, and to the user, appears to occur approximately simultaneously with the actuation of the sensor.

The force feedback is essentially a return force of the handle toward a center point (null) when the handle is away from the center point along or about any axis. The force feedback may be perceived by the user as a resistance to movement of the handle away from the center point. The force feedback additionally can serve as the handle return-to-center resilient structure. Additionally, the preferred structure provides a null region having a small amount of play or space along and about each axis wherein tolerance of the small inaccuracies of the human hand are accommodated absent unintended sensor actuation by the user. Preferably, the null region is in part provided by the return-to-center resilient structure and in combination with the particular sensor configuration, i.e., six pairs or twelve sensors which equates to a sensor pair or two sensors for bidirectional linear interpretation along each axis, and a sensor pair or two sensors for bi-directional rotational interpretion about each axis.

In one preferred 6 DOF embodiment the carriage supports eight sensors and the associated necessary electrical traces on a sheet surface at least in part within the housing. Rocker-style sensor activators, which are manufactured inexpensively by plastic injection molding, translate motion of the shaft relative to the carriage and motion of the carriage relative to the housing, to the eight sensors. The four remaining sensors and associated electrical traces, and possibly some desireable additional sensors such as for selection or fire buttons, may be supported upon a sheet surface at least in part within the handle. One preferred sheet surface is a generally rigid circuit board. Another preferred sheet surface is a multi-layer non-electrically conductive plastic structure