PATENT ASSIGNMENT

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NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
Cybernet Systems Corporation	02/22/1999

RECEIVING PARTY DATA

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PROPERTY NUMBERS Total: 5

Property Type	Number
Patent Number:	6104158
Patent Number:	6801008
Patent Number:	7345672
Patent Number:	6374255
Application Number:	11699116

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**PATENT
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Total Attachments: 5
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BILL OF SALE AND ASSIGNMENT

FOR GOOD AND VALUABLE CONSIDERATION, as set forth herein, the receipt of which is hereby acknowledged, the undersigned, as Seller, does hereby grant, bargain, sell, assign, transfer and deliver to the Buyer, Cybernet Haptic Systems Corporation, a Michigan corporation, all of Seller's right, title and interest in and to the tangible and intangible personal property listed on the attached Exhibit A. Seller also hereby warrants title to the same to have and to hold the same unto the Buyer, its successors and assigns forever, free, clear and discharged of all former grants, charges, taxes, judgments, mortgages, liens and encumbrances of whatever nature.

IN WITNESS WHEREOF, the undersigned has executed this instrument this _22_ day of _February_, 1999.

WITNESSES:

SELLER:

CYBERNET SYSTEMS CORPORATION

By: _____

Its: _____ PRESIDENT

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Exhibit A
List of Assets

<u>US Patents</u>

Number   Issued
5,389,865   Feb 14, 1995   Method and System for Providing A Tactile
                             Virtual Reality and Manipulator Defining An
                             Interface Device Therefore
Inventors: C. Jacobus, A. Riggs, M. Taylor

Claims method and device structure allowing general purpose force feedback user input devices, like joysticks, from computer simulations. This patent describes the elements of Cybernet's original force feedback device. Innovations include:
Peak Force/Power Management
Intelligent deadman's functions (software, communications failure checking as well as user input)
Basic force feedback software systems architecture (how one structures a reactive servo system into layers, how one defines and instantiates special effects or geometrical objects in an general purposed, extensible way
Device geometry (kinematic chain) for a pistol grip sidearm stick
Some design approaches for gravity compensation

Number   Issued   (Continuation of above)
5,459,382   Oct 17, 1995 Method and System for Providing A Tactile
                             Virtual Reality and Manipulator Defining An
                             Interface Device Therefore
Inventors: C. Jacobus, A. Riggs, M. Taylor

Claims the enabling software method and architecture for 5,389,865. This patent has been re-examined by the Patent Office in 1997, has been restricted in a positive way and has passed the re-examination. Re-examination certificate has issued. As a continuation, the disclosure is the same as above. Claims are structured to emphasize software architecture needed to provide generalized reactive servo system composed of active objects (which define behaviors of surfaces, 3D objects, and temporal effects). Also emphasizes architecture layers which can be partitioned between processors interconnected through communications media (wires or share memory). Restriction of claims has been in the direction of more fully defining what is meant by "generalized and extensible" representation of haptic objects or effects.

Number   Issued   (Reexamination Certificate for above)
B1 5,459,382 June 9, 1998   See above discussion
Inventors: C. Jacobus, A. Riggs, M. Taylor

Number   Issued   (Continuation of 5,389,865)
5,629,594   May 13, 1997 Force Feedback System
Inventors: C. Jacobus, A. Riggs, M. Taylor

Claims basic software method and specific hardware implementation methods derived from 5,389,865. This continuation further refines the claims derived from 5,389,865 by defining in a more complete way, what is meant by a virtual object made up of virtual surfaces. Specifically, it is made clear that this encompasses computer models typical of computer-aided design systems. It also describes how forces are superimposed from separate decomposable effects and describes further power management features for

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minimizing average power consumption while maintaining high peak forces. Identifies components of the architecture as to layer in which them are performed.

Number   Issued
5,754,023   May 19, 1998 Gyrostabilized Platforms for Force
                              Feedback Application
Inventors: G. Roston, C. Jacobus

Claims a gyrostabilized platform architecture which allows generation of forces without direct attachment to a ground platform (table top, floor, etc.). The basic innovation here is how one can implement an impulsive force feedback device without having the device physically attached to a fixed reference frame (like a table top). The approach can implement good sports equipment or gun recoil effects with a relatively unrestricted range of motion area.

Number   Issued
5,769,640   June 23, 1998 Method and System for Simulating Medical
                              Procedures including Virtual Reality and
                              Control Method and System for use Therein
Inventors: C. Jacobus, J. Griffin

Claims cover how medical image data and touch data are combined to make a force feedback or haptic medical training system. A force feedback enable endoscopic training system is disclosed in detail including:
        generation of realistic three dimensional imagery
        generation of realistic forces on instruments synchronized with the three
              dimensional imagery
        the mechanical architecture for a 4 degree of freedom haptic device which allows the
              insertion of realistic endoscopic instruments into typically three trocars

Number   Issued   (Continuation of 5,389,865)
5,831,408   Nov. 3 1998   Force Feedback System
Inventors: C. Jacobus, A. Riggs, M. Taylor

Additional software method claims derived from 5,389,865. Include refinemant of claims for multiaxis force generation as a superposition of independent forces generated from virtual objects like surfaces or effect. Includes additional refinment of the intelligent deadman concept, and further elaborates power versus peak force control.

Number   Issued
5,844,392   Dec. 1, 1998 Haptic Browsing
Inventors: T. Peurach, D. Haanpaa, T. Yocum, C. Jacobus

Claims cover the methods needed to translate three dimensional object descriptions into haptic (or force feedback) controls that simulate touching of the three dimensional objects. The complete software architecture and data object structure to implement effects and three dimensional space forms (splines, planes, conics, voxels, etc.) into a haptic system such as described in 5,389,865, 5,459,382, and 5,629,594 are described in depth. The primary innovations are partitioning of the systems into layers, and layers into independent superpositioned force functions (or in the case of geometrical entities, geometry elements).

Number   Issued
5,822,438   Feb. 16, 1999 Whole Body Kinesthetic Display
Inventors: G. Roston

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Claims cover a three dimensional treadmill or "foot haptic" device which allows free walking and running in any direction. The innovative technology disclosed includes how to make an electro-mechanical system with high strength and speed to weight ratio using electric motors and drives rather than electro-hydraulics. The architecture disclosed includes two independent mechanisms (for each foot) which operate in concert without collision to mirror the walking function. Control algorithms and how such a system connects into a distributed interactive simulation is described.

US Patents Pending

Number   Filed   (Continuation of 5,389,865)
09/185,301   Nov. 3, 1998 Force Feedback Systems
                           Examiner: P. Ip
                           Group Art Unit: 2837
                           Attorney Docket Code: cyb-00605/03
Inventors: C. Jacobus, A. Riggs, M. Taylor

Additional software method claims derived from 5,389,865.

Number   Filed
08/859,137   May 20, 1997 Haptic Device Attribute Control
                           Examiner:
                           Group Art Unit: 2107
                           Attorney Docket Code: cyb-3102/03
Inventors: T. Peurach, D. Haanpaa, T. Yocum, C. Jacobus

Claims cover using GUI elements to parameterize haptic (force feedback) control elements (software or hardware). This is required to make a "feel" editor. The innovative idea is to attach directly manipulatable physical or virtual (on computer screen) attribute control objects to parts or parameters in a force feedback control system (for instance, an intensity control which changes the value of a vibration effect or a stiffness control which changes the elasticity of the surface repulsive effect). This work was derivative of Cybernet's first GUI based haptic demonstration interfaces.

Number   Filed
08/859,877   May 21, 1997 Haptic Authoring
                           Examiner: W. Amsbury
                           Group Art Unit: 2771
                           Attorney Docket Code: cyb-03402/03
Inventors: T. Peurach, D. Haanpaa, T. Yocum, C. Jacobus

Claims cover the methods needed to author or create three dimensional object descriptions which include haptic (or force feedback) descriptions needed to simulate touching of the three dimensional objects (including a range of haptic texture methods). The innovative idea is the combination of methods needed to attach haptic parameters or specifications to effect and geometric object entities in an editing system such as a CAD/CAM system. Claims cover key requirements to combine graphical elements with haptic properties and how these combined entities are represented to drive a system such as that described in Haptic Browsing (above).

Number   Filed
09/185,152   Nov. 3, 1998 Haptic Pointing Devices
                           Examiner:

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Group Art Unit: 2837
Attorney Docket Code: cyb-04802
Inventors: Douglas Haanpaa, Gary Siebert, Terry Cussen, Kirk Fifer, Mike Dinsmore, Charles Jacobus

Describes a very low cost three dimensional force feedback CAD/CAM/pointing device design which is supported by Cybernet software methods patents. Its uses are similar to the Phantom by Sensable, but is implemented using an innovative drive method which provides substantially better quality force feedback of virtual objects and haptic textures, and has a cost of goods below $100.

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