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(54) **HAPTIC POINTING DEVICES**

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(58) **Field of Search** 318/568.11, 568.16; 414/7, 5; 74/471; 434/45

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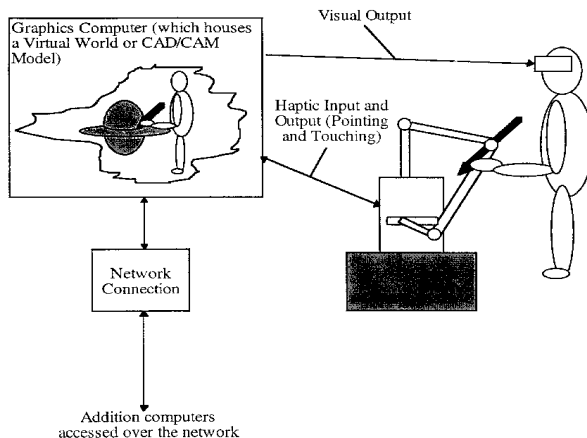
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(57) **ABSTRACT**

A haptic pointing device includes a plurality of rigid, elongated proximal members, each connected to a separate rigid, elongated distal member through an articulating joint. The other end of each proximal member is coupled to an actuator such as a motor, causing that member to swing within a separate plane perpendicular to the shaft of the motor in response to a control signal. An end-effector is interconnected to the second end of each distal member through an articulating joint, such that as the actuators move the proximal members, the end-effector moves in space. In a preferred embodiment, the device includes at least three proximal members and three distal members, and the end-effector is coupled to a user-graspable element such as a stylus which retains a preferred orientation in space as the members are driven by the actuators. In a force-feedback application, the haptic pointing device further includes a position sensor associated with each degree of freedom, and haptic processing means interfaced to a virtual reality system or teleoperations environment. Additional components may be provided to increase flexibility, degrees of freedom, or both.

25 Claims, 16 Drawing Sheets

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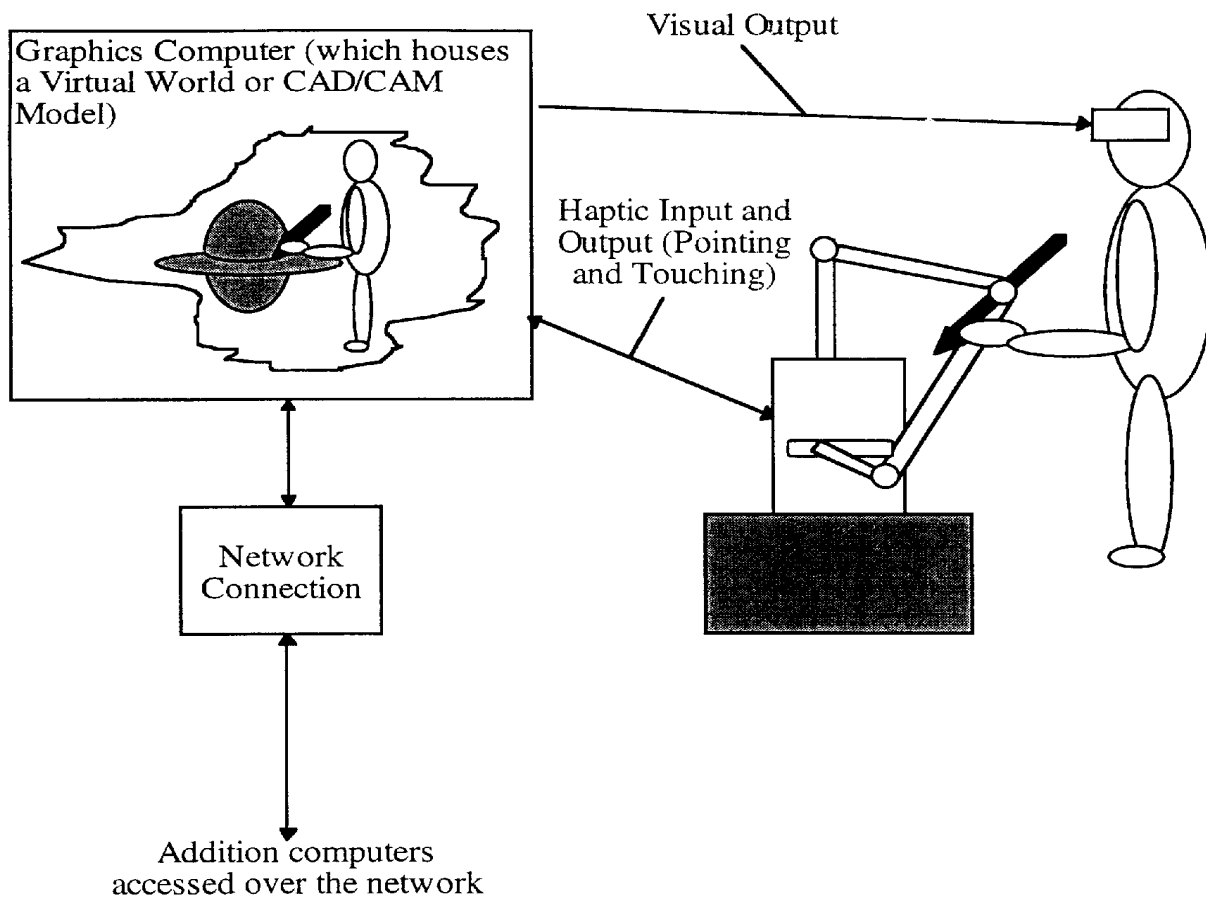
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Visual Output

Graphics Computer (which houses a Virtual World or CAD/CAM Model)

Haptic Input and Output (Pointing and Touching)

Network Connection

Addition computers accessed over the network

Figure 1

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