

## METHOD AND APPARATUS TO INPUT AND OUTPUT HAPTIC DATA

### FIELD OF THE INVENTION

[0001] The present invention relates to the field of haptels and methods for inputting and rendering haptic data.

### BACKGROUND OF THE INVENTION

[0002] When living beings are not within arms reach of each other, communication is limited to non-touch forms. Telephones provide audio communication over great distances, to assist the sense of hearing. Television and computer monitors have been developed to provide data in the form of a visual display. Examples of these prior art communication devices are shown in FIG. 1. FIG. 1 depicts prior art audio data transmission via telephone communication and visual data transmission and display on a computer monitor. With reference to FIG. 1, person 2 uses telephone 2a to communicate over signal path 10 with person 4 via telephone 4a. In a similar manner person 6 uses computer 6a to communicate over signal path 10 with person 8, via computer 8a. Computer 6a and 8a could be any type of prior art device that displays alphanumeric or graphic data. These prior art communication devices do not provide touch based (haptic) data input and output.

[0003] When living beings are proximate to each other, other forms of communication, beyond speaking, are employed. In particular, living beings communicate with their sense of touch. Physical contact, caressing, holding, squeezing, contact-examination are some of the forms of communication that living beings routinely employ when proximate to each other. FIG. 2 displays some of the touch-based forms of communication intended by a haptel. With reference to FIG. 2, touch 20 is indicated with two people. Holding 22 is indicated with one person's hand on another. Examination 24 involves touch-based contact as shown in FIG. 2.

[0004] A child's toy, "a set of nails," is a device that records the imprint of a user's hand or other object that is pressed against it. This device does not provide electrical signals that can be used to reproduce the imprint on a second device, nor does this device provide the ability to configure itself based on an external input.

[0005] A prior art rendering device that allows a blind person to read brail is a binary device that can be electronically driven. What the prior art does not provide is real-time haptic data input and output that can be used to create virtual touch and telepresence of living beings or objects that are not in direct contact with each other. What is needed are haptic input output devices so that haptic data can be transmitted and rendered.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The present invention is illustrated by way of example and is not limited in the figures of the accompanying drawings, in which like references indicate similar elements.

[0007] FIG. 1 depicts prior art audio data transmission via telephone communication and visual data transmission and display on a computer monitor.

[0008] FIG. 2 displays some of the other forms of communication intended by haptels.

[0009] FIG. 3 displays the input and output functions of a haptel.

[0010] FIG. 4 displays a haptel that combines input and output functions into one device.

[0011] FIG. 5 shows a user feeling the surface of an array of haptels.

[0012] FIG. 6 depicts virtual real-time touch and tickling of a baby's foot.

[0013] FIG. 7 displays an array of haptels configured with amplifiers, analogue to digital converters and a haptel memory buffer.

[0014] FIG. 8 shows a network of N HRDs.

### DETAILED DESCRIPTION

[0015] A haptel and haptic rendering device (HRD) are disclosed, which allow a user to virtually feel the texture of an environment or virtually touch another person's hand that lives on the other side of the continent. Haptel refers to a single haptic element. An HRD comprises one or more haptels, which will provide the user with the ability to feel a surface, object or another user. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one of ordinary skill in the art that these details need not be used to practice the present invention. In other circumstances, well-known structures, materials, circuits, processes and interfaces have not been shown or described in detail so that the present invention is not unnecessarily obscured.

[0016] A haptel may be used for both inputting and outputting haptic data. Haptic data may be any data, which defines the ontology of an object. Some examples of haptic data are coordinates that define spatial position, velocity, temperature, force, and pressure. Indirect forms of haptic data may be emotions, such as joy, or anger.

[0017] In one embodiment of the present invention, input and output functions of a haptel may be performed in separate devices. With reference to FIG. 3, a first user might have access to input haptel 30 and output haptel 32, while at another location a second user might have access to input haptel 34 and output haptel 36. The two users would be separated from each other, while the haptels were connected by signal path 10. User 1 would apply stimulus 30a to haptel element 30b such that signal 30c would be generated by input haptel 30. Signal 30c could travel through signal path 10 and be received and displayed on output haptel 36. Signal 30c might cause output haptel 36 to generate stimulus 36a resulting in signal 30c being rendered on haptel element 36b. In a similar manner, although not shown on FIG. 3, is the concurrent ability for user 2 to generate a signal with input haptel 34 that would be rendered or displayed on output haptel 32, which could be read by user 1.

[0018] For the purposes of illustration, haptel element 30b and 36b, in FIG. 3, are depicted as pins, which may move up and down in frame 30d and 36d, respectively. Many alternative mechanisms may be employed according to the present invention to serve as a haptel. For example, a piston