the hardware configuration for the mobile tactile display with the present invention incorporated.

[C-1] Movement of stimulation presentation using the thumb (Scroll);

[C-2] Changing of presentation stimulation according to orientation; and

[C-3] Separation of an electrode section from a main circuit.

[C-1] Method of Moving Presented Stimulation Using Thumb

Background and Object

[0096] The mobile tactile display has a problem in comparison to desktop type tactile display of the related art with respect to in what manner scrolling of presented tactile sensations should take place. For example, when Braille is presented, Braille of a few characters to a few tens of characters is lined up in a row for display at stationary type tactile display, with the user then tracing on these characters. However, with the mobile tactile display, a presentation portion can only be in the order of from one character to a few characters for Braille, and a method of moving a finger relative to the display is therefore not appropriate. It is thought to be appropriate to emulate relative movement of a finger and display by having a presentation pattern flow as with an electrically lit presentation board.

[0097] In the technology of the related art, a method is proposed where a tactile sense presentation apparatus is mounted on a device capable of detecting its own movement such as a mouse. The user then moves this device so that there is the feeling that a pattern fixed spatially is being traced as a result of changing the presentation pattern according to this movement. In this procedure, the apparatus for detecting movement is made large, and the operator handles the apparatus as a desktop tactile sense presenting apparatus even when carrying the apparatus outside and this apparatus cannot be said to be easy to use.

Resolving Means

[0098] In regard to this, we propose a method for changing the presented pattern as result of operating in cooperation with a different finger to the finger tactile sensations are presented to. In FIG. **15**, tactile sensations are presented to the forefinger, while the presented pattern is controlled using the thumb. An example of a specific internal configuration is shown in FIG. **16**. A mobile tactile display T is comprised of a plate-shaped body, an electrode array composed of a plurality of electrodes provided at the surface of the body, and a plurality of film-shaped force sensors embedded in the body. The body is provided by sticking together two square-shaped plates, with a plurality of force sensors being interposed between the two plates. Electrodes for tactile sense presentation are arranged on the forefinger side. Force sensors are arranged between the thumb and the forefinger. It is then possible to detect where is currently being pressed by the thumb using the plurality of sensors. As a result of this, it is possible to move a pattern presented to the forefinger as a result of a tracing operation of the thumb.

[0099] A plurality of sensors are required to detect the direction of tracing of the finger. An example arrangement for the case of using film-shaped force sensors as force sensors is shown in FIG. **17**. In FIG. **17**A, the position of the center of gravity of force currently being applied or the direction of the force is detected by four film-shaped force sensors. In this case, movement information for the finger can be detected with two degrees of freedom (up, down, left and right directions). If the direction of movement of the presented patter is limited to one direction, it is possible to adopt a configuration as in FIG. **17**B where the number of force sensors can be reduced.

[0100] By moving the presentation pattern corresponding to the tracing operation of a finger, the user operates as if the user has a plate written with Braille between the finger presented with the tactile sensations and the tracing finger. It is therefore possible to handle this plate as if the plate is being actively moved. The user can therefore actively control the tracing speed, and can obtain a higher recognition performance due to movement of tactile sensations matching with movement of a finger that is active instructions of a person. It is possible to provide the volume function disclosed in [A-3] using the force sensor here.

[0101] It is also known that it is possible to determine contact of a finger and detect a tracing operation of a finger using methods such as optical methods or capacitance methods rather than using sensors. Further, a tracing operation of a finger is by no means essential and a method such as a so-called joy stick where a presented pattern is made to move by detecting the direction of pressing force is also possible. Namely, detection of the orientation of a finger is possible in place of detection of the amount of movement of a finger.

[C-2] Changing of Stimulation Presentation According to Orientation

Background and Object

[0102] With the desktop type tactile sense presentation apparatus of the related art, the pad of the finger is always directed downwards so as to make contact with the desktop display surface. With regards to this, with a mobile type tactile presentation apparatus, the apparatus is of a size that can be put in a hand and the orientation of the hand changes. Here, it is necessary to change the presentation pattern and the scroll direction.

Resolving Means

[0103] For example, a presentation pattern scrolled from right to left when the pad of the finger is directed downwards is made to be a scroll from left to right when the pad of the finger is directed upwards. As a result, scrolling is always from right to left when viewed from the body as a whole of the user. A person therefore perceives the direction of movement of a tactile sensation using a coordinate system for the body as a whole rather than a coordinate system for the tip of a finger, and recognition performance can be improved by making this kind of change. The orientation of the stimulation apparatus can be obtained by measuring the gravitational direction using, for example, a built-in acceleration sensor. The technological idea of changing presented patterns and scrolling direction using so-called world coordinates is by no means limited to electrical stimulation apparatus but can also be adopted in other mobile devices.

[C-3] Separation of an Electrode Section from a Main Circuit

Background and Object

[0104] With an electrical stimulation apparatus, situations where electrodes and circuits are integrated are common in the related art. With regards to this, when considering port-