401 and the electronic device 402. That is, as illustrated in FIG. 4A, the dynamic tactile interface 10 forms at least part of the user interface (UI) 20 between the user 401 and the electronic device 402. During operation of the electronic device 402, the displayed visual image 14 may change, in response to detecting a user interaction with the dynamic tactile interface, thus creating different areas of the device 10 that provide opportunity for tactile feedback. For example, the visual image 14 on the device 10 may be a web page that includes buttons, links or other indicia 16 for selection or "clicking" by a user. The areas of these indicia 16 on the visual image 14 are the areas of tactile feedback on the dynamic tactile interface 10 for which increased accuracy or ease of use may be desired.

[0023] The dynamic tactile interface 10 may be implemented in, on, or in conjunction with any electronic device 402 generally known in the art having or utilizing a touch screen interface (e.g., computer, laptop, video game screen or console, personal digital assistant, mobile phone, mobile media player, other touch-screen interfaces, etc.). In some embodiments, the dynamic tactile interface 10 is implemented in or as part of the touch screen interface of a mobile phone. In some additional embodiments, the electrostatic tactile interface 10 is implemented in a tactile keyboard and provides tactile feedback in areas of a keyboard where the keys are normally located. In still some other embodiments, the dynamic tactile interface 10 is implemented in a non-viewable part of a device, such as in the touchpad of a laptop computer and provides tactile feedback, for example, in the areas of the touchpad that represent the left and right mouse buttons. In one example, virtual buttons of an input device (e.g., a keypad, a keyboard, arrow keys, characters, numbers, symbols, etc.) might be presented by tactile feedback on the dynamic tactile interface 10. The texture of the virtual buttons (e.g., an outline of a key, a detent or registration dot for a key, Braille representations, etc.) for the input device might also be presented with tactile feedback within the virtual buttons on the dynamic tactile interface 10, such that multiple virtual buttons may be distinguished from one another.

[0024] FIG. 1A is a side view illustrating a dynamic tactile device with a touch screen interface. The dynamic tactile interface 10 may include partially conducting layer 101, an electrostatic film 102, a plurality of cells 112, a plurality of support members 103, and a plurality of electrodes 104. The individual support members 103 are each either a longitudinal member or a latitudinal member; the plurality of support members 103 are arranged to form a cell matrix, which may be comprised of an uniform integral body (e.g., as illustrated in FIG. 2A) or as separate, disjointed longitudinal and latitudinal members (not shown). The plurality of support members 103 support the electrostatic film 102 and separate the electrostatic film 102 from the electrodes 104, with the electrostatic film 102 being placed on top of the plurality of support members 103 and the electrodes 104 on the bottom of the support members 103. Cells 112 are formed by the interior space bounded by the combination of the plurality of support members 103, the electrostatic film 102, and electrodes 104.

[0025] FIG. 4B is a side view illustrating a user-interface surface according to the dynamic tactile interface of FIG. 1A with the electrostatic film 102 and the partially conductive layer 101 acting as the user-interface surface between the user 401 and the touch screen device 402.

[0026] The support members 103 are arranged generally perpendicular to both the electrostatic film 102 and the electrodes 104. The support members 103 are arranged in a cell matrix layout with an electrode 104 located at the bottom of the cell 112. For example, if the support members 103 are arranged so that there is a 5×10 matrix, then the electrodes 104 are arranged in a 5×10 matrix with each individual electrode 104 corresponding to a single cell 112 in the cell matrix. The support members 103 may be made of any number of materials generally known in the art having dielectric constants that minimize tunneling between adjacent electrodes, including positive or negative photoresist (e.g., epoxy-based polymer, phenol formaldehyde resin). The support members 103 may be rectangular, hexagonal, circular, or of another shape, and provide the structure against which the electrostatic film 102 is attracted to, or repelled from, the bottom electrodes 104. In some embodiments, the support members 103 are formed in a manner such that they can "breathe," allowing air to enter and exit the cell 112. In some embodiments, the support members 103 are sealed with a negative or positive pressure, thus creating a steady indent state or bump state (described in greater detail below).

[0027] The electrostatic film 102 is formed from any number of materials generally known in the art having appropriate properties for the dynamic tactile interface, including materials of the triboelectric series (e.g., silicone rubber, PTFE, PCTFE, PVC, polypropylene, and polyethylene). Other materials having sufficient elasticity such that they allow for the creation of indents and bumps may also be used. In some embodiments, the electrostatic film 102 has a generally constant negative charge. In some embodiments, a partially conductive layer 101 is placed on or above the electrostatic film 102 to keep the film 102 in a constant state of charge. In some embodiments, the partially conductive layer 101 is not needed because the electrostatic film 102 itself is partially conductive, but only to the extent that adequate charge can be maintained and does not leak across the cells 112.

[0028] FIGS. 1B and 1C are a side views illustrating an "indent" state 114 and "bump" state 116, respectively, of a cell 112 according to the dynamic tactile interface 10 of FIG. 1A. The electrodes 104 may be excited with a positive or negative charge. In the example illustrated in FIG. 1B, the electrode 104 has a positive charge. As described, the electrodes 104 are arranged in a cell matrix pattern. In FIG. 1B, the individual electrode 104 corresponds to an element, or cell 112, of the cell matrix. By applying a positive charge to the electrode 104, the portion of electrostatic film 102 and the partially conductive layer 101 immediately above the electrode 104 (i.e., the area above the cell 112 corresponding to the positively charged electrode 104) is attracted to the electrode because it is negatively charged, thus creating an "indent" state, or indentation 114. In FIG. 1C, the electrode has a negative charge. When a negative charge is applied to the electrode 104, the portion of the electrostatic film 102 and the partially conductive layer 101 immediately above the corresponding cell 112 of the excited electrode 104 will repel from the electrode, thus creating a "bump" state, or protrusion 116.

[0029] FIG. 3A is a circuit diagram illustrating a charge circuit 350 according to the dynamic tactile interface 10 of FIG. 1A. The charge circuit 350 may include an address line selector 370, a V^- address line 310, and a V^+ address line 320. Addressing schemes similar to static RAM addressing schemes may be implemented to address the electrodes 104. The electrodes 104 of the dynamic tactile interface 10 discussed with reference to FIGS. 1A-2B are coupled to a V^-