configured for incorporation on a multi-mode, microprocessor-controlled wireless handheld device **300**. The handheld device **300** can be a two-way mobile communication device having electronic messaging communications capabilities and possibly also voice communications capabilities. Depending on the functionality provided by the handheld device **300**, in various embodiments the handheld device **300** may be a data communication device, a multiple-mode communications device configured for both data and voice communication, a mobile telephone, a personal digital assistance (PDA) enabled for wireless communication, etc.

[0027] The HTS display screen **322** may comprise a visual display that variously presents visibly different key arrangements to an operator or user of the handheld device **300** as a function of the mode of operation of the incorporating handheld device **300**. Examples regarding the visibly different key arrangements are presented herein below. These examples are provided for illustrative purposes and are not intended to limit the presentation of the visibly different key arrangements to the ones described below. Further, the HTS display screen **322** comprises a display-presented key arrangement **280** taking the form of one of the following: a navigational key arrangement, a text entry key arrangement, a symbol entry key arrangement, and numeric entry key arrangement. These examples are provided for illustrative purposes and are not intended to limit the presentation of the visibly different key arrangements to the ones described below.

[0028] The HTS display screen **322** is capable of variably presenting visibly different key arrangements to an operator of the device **300**. These different key arrangements can be shown to the user through the display screen **322**. This enables the key arrangement to be tailored to a specific application running on the handheld device **300** or mode in which the device **300** is currently operating. Some examples of programs that the device **300** could be capable of running include an email application, a memo application, a calendar application, and an address book. These various applications could require different types of input devices such as an alphabetic key arrangement to enter textual data into the application, such as the memo application. If the handheld device **300** is being operated in a mode such that it is enabled to dial or receive telephone calls, a telephone keypad can be displayed on the display screen **322** to enable the user to enter telephone numbers or other related information. Likewise in a data communication mode, the display screen **322** features an alphabetic key arrangement to enable entry of alphabetic characters and other textual data such as symbols and punctuation. In at least one embodiment, the display screen **322** presents an alphanumeric key arrangement to enable entry of alphabetic or numeric characters and other textual data such as symbols and punctuation, while in the data communication mode.

[0029] In the case of virtual keys, the indicia for the respective keys are shown on the display screen **322**, which in one exemplary embodiment is enabled by touching the display screen **322**, for example, with a fingertip to generate the character or activate the indicated command or function. Some examples of display screens **322** capable of detecting a touch include resistive, capacitive, projected capacitive, infrared, and surface acoustic wave (SAW) touchscreens. According to this disclosure, as alluded to above, such a touchscreen is configured to provide tactile feedback to the user when the user touches and activates a button, icon, or other GUI presented on the display screen, i.e., it is a haptic, touch-sensitive (HTS) display screen.

[0030] Details as to the configuration of such an HTS display screen **322** are illustrated in FIGS. **3**A and **3**B. As shown in FIG. **3**A, the display screen includes as primary components a color LCD stack-up **325**; a lens cover **327** disposed over the LCD stack-up **325** to protect it; a touch-sensitive assembly **329** configured and disposed to sense when a user touches the screen (e.g., with a fingertip) and to identify to the device's microprocessor where that contact has occurred; and a haptic (i.e., feedback-providing) layer **331**. The LCD stack-up **325** suitably includes a bottom polarizer **333**, a bottom glass plate **335**, a liquid crystal layer **337**, a top glass plate **339** and a top polarizer **341**, along with suitable color filter elements (not shown), e.g., red, green, and blue color filter elements, as is known in the art. In the illustrated embodiment, the touch-sensitive assembly **329** is disposed on the inner surface of the lens cover **327**, with an optional gap **343** between the touch-sensitive assembly **329** and the LCD stack-up **325**. Suitably, the touch-sensitive assembly is a resistive assembly, a capacitive assembly, a projected capacitive assembly, an infrared assembly, a surface acoustic wave (SAW) assembly, or any other known type of assembly used in the construction of touch-sensitive screens and known in the art.

[0031] As shown in more detail in FIG. **3**B, the haptic layer **331** is formed as a gridwork of transparent electrical conductors in the form of an indium tin oxide (ITO) film or an antimony tin oxide (ATO) film disposed on the exterior (upper) surface of the lens cover **327**. Suitably, the conductors may be formed in the shape of interleaved combs, with the "teeth" or "times" of one comb extending between the teeth or tines of the other comb and each comb constituting an electrical conductor. The width between adjacent grid lines is optimized at about five millimeters, so that when a user touches the screen at any location, his finger will overlap and touch at least one grid line of each of the two electrical conductor combs. In this manner, the user's fingertip will complete an electrical circuit. Other conductor grid patterns besides interleaved combs, configured such that a user's fingertip can overlap conductors to complete an electrical circuit are considered within the scope of this disclosure.

[0032] The handheld device further includes a pulse generator that supplies very low level electric current to the conductor combs of the haptic layer **331**. Electric pulses on the order of about 0.2 to about 0.5 milliseconds are generated when the microprocessor determines that the screen **322** has not only been touched (i.e., by means of touch-sensitive assembly **329**), but also that it has specifically been touched at the location of a button, screen icon, or other GUI so as to enter input into the handheld device or make a selection of some sort. As a result, the user is provided with a very slight tingling or buzzing feel in their fingertip that lets them know that a button or icon has been "pressed," that a selection has been made, etc., and that the device has registered it. The electrical pulses may be rendered as a short burst of one positive pulse followed by one negative pulse. Furthermore, given the resistance of human skin (up to 100 kΩ), the pulse generator generates pulses on the order of 100 Volts (positive or negative), up to about 200 Volts, so that the user can sense the pulse. The amperage, however, is generally quite small so that the user is not shocked. In particular, for safety, the current should be controlled such that it is less than 5 milliamps, with a preferred level being around two to three milli-