tion. In this case, deformable surface/extension **704-0** may protrude to indicate a leftward direction, while deformable surface **704-1** may protrude to indicate a rightward direction. In another example, such a device can perform specific predetermined effects (e.g., pulsation, heartbeat, etc.), which could be of value in virtual tele-presence and social networking applications. In a heartbeat example, the heartbeat of a user could be emulated by expanding and contracting deformable pads **704-0** and **704-1** on the sides of device **700** or **750** at the other end of a phone connection.

[0033] In the case of entering a text message on a cell phone, where normally a device is held with both hands to allow for two thumbs to press the number pad buttons, usable space may be constrained. In such a case, deformable surfaces (e.g., extensions **704**) can be activated on the back and/or the sides of the enclosure of the device, such that device gripping can be facilitated. The deformable surfaces or shape can be controlled to provide predetermined pressure patterns along the contact area between hand and device. Therefore, for various gestures of the hands or fingers, a user can perform a relatively smooth writing task, as well as possibly improve text entry speed and accuracy.

[0034] Particular embodiments can include shape changing for accommodation of individual ergonomics. For example, a cell phone can automatically adjust from a relatively thin shape for call dialing to a thicker shape for sending text messaging or other keypad intensive activity, or can change shape depending on if the user is holding the phone with one hand or with both hands. In particular embodiments, such a device can detect or otherwise receive information regarding a particular mode or activation of an application (e.g., call application, texting application, etc.), and then make shape adjustments accordingly. Further, a user may program preferences (e.g., an extension of about 1 cm on the right device side during texting applications) for particular applications. In the example of FIG. **2**, particular embodiments can include controlled activation of extra retractable pieces, swelling material (e.g., EAP), or the like, to accomplish the wider shapes as illustrated.

[0035] The shape of an outer enclosure of a cell phone is normally designed for holding with one hand while talking. An advantage of using a shape changing cellular phone is to provide gross motions of deformable surfaces for facilitating alteration of the geometric shape of the device (e.g., via deformable surfaces/extensions **704**) for a specific application. Another advantage of using a shape changing device is to adjust the general form of the device to achieve a more comfortable interaction and/or improve ergonomic properties.

[0036] FIG. **3** illustrates an example of a cell phone **800** with a slider bar surface characteristic in accordance with embodiments of the present invention. Any predetermined shapes can be configured to appear on a surface of a device. Such shapes can be controlled by controlling individual actuator elements or sub-arrays of haptic actuators. For example, if a user intends to scroll a long list of contacts (e.g., items **804-0**, **804-1**, . . . , **804**-N) on a touchscreen cell phone, a scroll thumb (e.g., **802**) with added tactile feedback can be enacted (e.g., by using extension **704-1**) to allow for an intuitive input/output interface with the device.

[0037] When cell phone **800** is being used in music player mode, a list of songs can be scrolled. A deformable and/or flexible surface can be employed to form a virtual scroll box with a custom shape on one or more sides of phone **800**, and scrollbar **802** is configured to move along the scrollbox in response to a user pushing the scrollbar up/down. Moreover, localized haptic vibrotactile feedback can also be incorporated on the flexible surface to convey specific information, such as when the scrollbox is close to the top or bottom of the song list, or when a new group of contact names starts in the list. A portable handheld device such as device **800** having a deformable slider or scrollbox is applicable to various digital information applications such as data search as well as haptic feedback.

[0038] FIGS. **4***a*-**4***c* are block diagrams illustrating examples of shape changing gaming devices **900**, **930**, and **960** in accordance with embodiments of the present invention. Changing of shape in such devices **902** allows for communicating various information **904** and haptic effects from the game environment to the user. For example, the gaming device shape can be adjusted to become closer to a geometric form of a tool (e.g., a shape of a weapon **906** as may be used in a game, or other appropriate shape **910**, etc.) that is virtually held by a user's hand in the gaming environment.

[0039] As shown in FIG. **4***a*-**4***c*, different types of data (e.g., a button **908** that gets smaller as life in game or time remaining is reduced, status of a player, etc.), associated with various scenarios occurring in a computer game can be displayed by activating deformable surfaces on a side and/or back of computer game controllers. Further, vibrotactile and/or kinesthetic effects can be emulated on gaming device surfaces to incorporate haptic feedback associated with interaction of the virtual player with the objects in the game.

[0040] In this fashion, devices in particular embodiments can include a flexible surface that changes macroscopic shapes or characteristics. Such shape changes can be in response to applications or operating states/modes of the device, as opposed to any direct user action. Further, an actuator in the form of a haptic substrate of particular embodiments can support vibrotactile and/or kinesthetic effects. As illustrated, in the devices of FIG. **4**, specific shapes are formed on the side of the device to indicate game status or a weapon, for example, as opposed to merely changing the shape of a handle.

[0041] FIG. **5** is a block diagram illustrating a shape changing device **500** emulating a tennis racket gaming console in accordance with embodiments of the present invention. Shape changing device **500** includes a display **502** and a handle **504**. In some embodiments handle **504** includes shape changing haptic mechanisms **506**, **508**. In one embodiment, device **500** is a remote gaming apparatus in which device **500** can be configured to be one of several gaming controllers and/or consoles.

[0042] Display **502**, in one embodiment, is capable of displaying an image in connection to a game to be played. For example, device **500** is emulating a tennis racket so display **502** displays an image of a frame **512** with a tightly interlaced network of strings. In another embodiment, device **500** may not include display **502**, and instead may include actual physical "strings" or other suitable indicia. Handle **504**, in one example, also includes shape changing haptic mechanisms **506**, **508** that either or both are capable of expanding or contracting physical shape and/or size in one or more directions (illustrated in FIG. **5** as inwardly and outwardly by the arrows). The activation or deactivation of haptic mechanisms **506**, **508** may be associated with the location of a tennis ball hitting the racket to simulate the quality of the stroke and/or location of the contact of the ball with the face of the racket (e.g., "sweet spot," edge, top, bottom, left, right, etc.).