ration of the tactile pixels **104** may respond to a tilt sensor. For instance, as shown in FIGS. **6**A-**6**B, the device **100** may include a tilt sensor **121** mounted within the case **101**. The tilt sensor **116** may be coupled to the processor **106**. The tilt sensor **121** may produce a signal input that depends on the relative orientation of the case **101** and this signal may be used to change the state of the tactile pixels **104**. For example, as shown in FIG. **6**A, when the tilt sensor **121** senses that the case is held level, a particular subset of the tactile pixels **104** may be raised. In this case, two tactile pixels **104**A, **104**B closest to an axis of rotation Y may be raised. When the case **101** is tilted the tilt sensor **121** may produce a signal proportional to the magnitude of the tilt and sensitive to the direction of tilt. The tactile pixel driver **114** may be configured to cause the tactile pixels **104**A, **104**B closest to the axis Y to be lowered and one or more tactile pixels **104**C, **104**D further away from the axis to be raised, as shown in FIG. **6**B. The effect of a bubble level may be simulated by selectively raising and lowering tactile pixels in response to signals from the tilt sensor **121** as shown in FIGS. **6**A-**6**B.

[0044] In some embodiments of the present invention an array of electromechanical tactile pixels of the type described above may be used as the equivalent to touch screen. For example, as shown in FIG. **7**, a device **700** may include a case **701** and a touch screen **702** formed from an array of tactile pixels **704** may be disposed on a major surface of the case **701**. The tactile pixels **704** may be implemented as described above with respect to tactile pixels **104**, e.g., with piezoelectric actuator/sensors. A processor **706** may be operably coupled to the touch screen. The device **700** may be configured to operate as a game device, a phone, a portable media player, an email device, web browser device and the like.

[0045] Each of the tactile pixels **704** in the array includes an actuatable portion **705** coupled to an actuator **707** and a sensor **709**. The actuator and sensor are coupled to the processor **706**. The actuator **707** is configured to actuate in response to instructions from the processor **706**. The sensor **709** is configured to generate signals when pressure is applied to the actuatable portion **705**. The signals may act as inputs to as inputs to one or more programs **710** stored in a memory **708** and executed by the processor **706**. The programs **710** may include a specially configured tactile pixel array driver **714**. The actuatable portion **705** is actuatable by the actuator **707** between first and second positions in response to execution of one or more instructions by the processor **706**. A tactile feel of the actuatable portion **705** is different in the first and second positions.

[0046] The device **700** may also include well-known support functions, such as input/output (I/O) elements **711**, power supplies (P/S) **713**, a clock (CLK) **715** and cache **717**. The device **700** may optionally include a mass storage device **719** such as a disk drive, CD-ROM drive, flash drive, or the like to store programs and/or data. The tactile pixels **704**, processor **706**, memory **708** and other components of the device **100** may exchange signals (e.g., code instructions and data) with each other via a system bus **120** as shown in FIG. **1**A. In some embodiments, the device **700** may include a network interface **716**, configured to allow the device to exchange signals with other devices over a network. Furthermore, the hand-held device **700** may include one or more sensors **718**. Such sensors may include, e.g., an inertial sensor such as an accelerometer or tilt sensor, an optical sensor, an acoustic sensor such as a microphone or microphone array. The sensors may generate inputs to the program instructions **710** that reflect the environment in which the hand-held device operates.

[0047] All of the features described above with respect to the hand-held device **100** may also be applied to the device **700**.

[0048] While the above is a complete description of the preferred embodiment of the present invention, it is possible to use various alternatives, modifications and equivalents. Therefore, the scope of the present invention should be determined not with reference to the above description but should, instead, be determined with reference to the appended claims, along with their full scope of equivalents. Any feature described herein, whether preferred or not, may be combined with any other feature described herein, whether preferred or not. In the claims that follow, the indefinite article "A" or "An" refers to a quantity of one or more of the item following the article, except where expressly stated otherwise. The appended claims are not to be interpreted as including means-plus-function limitations, unless such a limitation is explicitly recited in a given claim using the phrase "means for."

What is claimed is:

1. A hand-held electronic device, comprising:

a case having one or more major surfaces;

a touch screen disposed on at least one of the major surfaces;

a processor operably coupled to the touch screen; and

one or more tactile pixels disposed proximate the touch screen, wherein each of the one or more tactile pixels includes an actuatable portion coupled to an actuator and a sensor, wherein the actuator is coupled to the processor, wherein the actuator is configured to actuate in response to instructions from the processor and wherein the sensor is configured to generate signals as inputs to one or more programs executed by the processor when pressure is applied to the actuatable portion, wherein the actuatable portion is actuatable by the actuator between first and second positions in response to execution of one or more instructions by the processor, wherein a tactile feel of the actuatable portion in the first position is different from the tactile feel of the actuatable portion in the second position.

2. The device of claim **1** wherein the one or more tactile pixels are located on the same major surface of the case as the touch screen.

3. The device of claim **1** wherein the one or more tactile pixels are located on a side edge of the case proximate the major surface on which the touch screen is disposed.

4. The device of claim **1** wherein the case includes a beveled edge between a side edge and the major surface on which the touch screen is disposed, wherein the one or more tactile pixels are located on the beveled edge.

5. The device of claim **1** wherein the device is configured such that the one or more of the tactile pixels are positioned to provide tactile feedback to a user and/or receive input from a user in response to a predetermined state of the touch screen.

6. The device of claim **5** wherein the device is configured such that a particular one or more of the one or more of the tactile pixels selectively actuate to mark an endpoint of scrolling of an image displayed on the touch screen.

7. The device of claim **5** wherein the device is configured such that a particular one or more of the one or more tactile pixels vibrate in response to the change in state of the touch screen.