114 may comprise a touch-screen or a touch-pad. For example, in some embodiments, touch-sensitive interface **114** may comprise a touch-screen mounted overtop of a display configured to receive a display signal and output an image to the user. In other embodiments, the touch-sensitive interface may comprise a button, switch, scroll wheel, roller ball, or some other type of physical device interface known in the art. In some embodiments, processor **110** is in communication with a single touch-sensitive interface **114**. In other embodiments, processor **110** is in communication with a plurality of touch-sensitive interfaces **114**, for example, a touch-screen and a roller ball. Touch-sensitive interface **114** is configured to detect user interaction, and based at least in part on the user interaction, transmit signals to the processor. In some embodiments, touch-sensitive interface **114** may be configured to detect multiple aspects of the user interaction. For example, touch-sensitive interface **114** may detect the speed and pressure of a user interaction and incorporate this information into the interface signal.

[0068] Next, processor **110** determines a haptic effect comprising a texture **406**. The haptic effect may comprise a vibration that the user may feel through the surface of a touch-sensitive interface or a manipulandum. In some embodiments, this vibration may cause the user to feel a texture on the surface of the touch-sensitive interface. For example, the texture of leather, snow, sand, ice, skin, or some other surface. In some embodiments, determining a haptic effect may comprise a series of calculations to determine the haptic effect. In other embodiments, determining the haptic effect may comprise accessing a lookup table to determine the appropriate haptic effect. In still other embodiments, determining the haptic effect may comprise a combination of lookup tables and algorithms.

[0069] In some embodiments, determining the haptic effect may comprise a haptic map. In such an embodiment, determining the haptic effect may comprise mapping the display signal to the actuators. For example, the display signal may comprise a plurality of pixels, each of the pixels associated with a color. In such an embodiment, determining the haptic effect may comprise assigning a haptic effect to each color. Then processor **110** will output a haptic signal comprising the haptic effect. In some embodiments, processor **110** may assign a haptic effect to only some of the pixels in the display signal. For example, in such an embodiment, the haptic effect may be associated with only a portion of the display signal.

[0070] In some embodiments, processor **110** may determine the haptic effect based, at least in part, on a user interaction or trigger. In such an embodiment, processor **110** receives an interface signal from touch-sensitive interface **114**, and determines the haptic effect based at least in part on the interface signal. For example, in some embodiments, processor **110** may determine different intensity haptic effects based on the interface signal received from touch-sensitive interface **114**. For example, if touch-sensitive interface **114** detects a high pressure user interaction, processor **110** may determine a high intensity haptic effect. In another embodiment, if touch-sensitive interface **114** detects a low pressure user interaction, processor **110** may determine a low intensity haptic effect. In still other embodiments, processor **110** may determine a low intensity haptic effect when touch-sensitive interface **114** detects low speed user interaction. Further, processor **110** may determine high intensity haptic effects when touch-sensitive interface **114** detects a high speed user interaction. In still other embodiments, processor **110** may determine no haptic effect, unless it receives an interface signal comprising a user interaction from touch-sensitive interface **114**.

[0071] Finally, processor **110** transmits a haptic signal associated with the haptic effect to actuator **118**, which is configured to receive the haptic signal and output the haptic effect **408**. Actuator **118** is configured to receive a haptic signal from processor **110** and generate the haptic effect. Actuator **118** may be, for example, a piezoelectric actuator, an electric motor, an electro-magnetic actuator, a voice coil, a linear resonant actuator, a shape memory alloy, an electro-active polymer, a solenoid, an eccentric rotating mass motor (ERM), or a linear resonant actuator (LRA).

[0072] FIG. **5***a* is an illustration of one of the textures that a texture engine may generate according to one embodiment of the present invention. The embodiment shown in FIG. **5***a* comprises brick. The texture of brick is characterized by having a rough irregular texture from bricks, punctuated with the feel of gritty valleys from the mortar. A system for a texture engine may generate the rough irregular texture of brick by driving an actuator, such as a LRA, LPA, or FPA, with a random signal with medium to high maximum variance while the user's finger is moving. In some embodiments, this variance may be adjusted for different roughness. In some embodiments, the transition from brick to mortar may be rendered by a high duration pop created by an ERM. Additionally, if the mortar is thick enough, a fine texture may be rendered by driving an actuator with a lower magnitude signal with a higher variance than that used to drive the actuator outputting the texture of the brick.

[0073] FIG. **5***b* is an illustration of one of the textures that a texture engine may generate according to one embodiment of the present invention. The embodiment shown in FIG. **5***b* comprises rocks. The texture of rocks is characterized by smooth surfaces punctuated with transitions as the user moves from rock to rock. In order to output the texture of a rock, an actuator, such as an FPA, is used to create patches of low friction. Individual rocks may be rendered by a non-visual edge map of the displayed image, and outputting a high magnitude haptic signal to an actuator, such as an LPA or ERM, when the touch-sensitive interface detects the user's movement. For example, outputting the haptic effect whenever the touch-sensitive interface detects that the user's finger is transitioning from one rock to another.

[0074] FIG. **5***c* is an illustration of one of the textures that a texture engine may generate according to one embodiment of the present invention. The embodiment shown in FIG. **5***c* comprises sand or sandpaper. Sand is characterized by a rough, gritty feel as well as the sensation a pile of sand particles building up in front of the user's finger. In order to output the rough gritty texture, of sand, an actuator, such as an LRA, LPA or FPA is driven with a random signal with high maximum variance while the user's finger is moving. In some embodiments, the processor may adjust the variance of the signal to create different degrees of roughness. To create the feeling of sand piling up, an actuator such as an FPA may be used. In such an embodiment, when user moves their finger across the touch screen, the processor will drive the actuator with a signal that starts with a low intensity and builds as the user moves his/her finger in one direction.

[0075] In another embodiment, the texture shown in FIG. **5***c* may comprise sandpaper. Sandpaper is characterized by having a rough, gritty feel. To create the rough, gritty feel the processor drives an actuator, such as an LRA, LPA or FPA