[0026] FIG. **5***h* is another illustration of one of the textures that a texture engine may generate according to one embodiment of the present invention.

DETAILED DESCRIPTION

[0027] Embodiments of the present invention provide systems and methods for a texture engine.

Illustrative Embodiment of a Texture Engine

[0028] One illustrative embodiment of the present invention comprises a messaging device, such as a mobile phone. In the illustrative embodiment, the messaging device comprises the Samsung Haptic Phone (SCH-W420) equipped with Immersion Corporation's TouchSense® 3000, TouchSense® 4000, or TouchSense® 5000 vibrotactile feedback systems, formerly known as Immersion Corporation's VibeTonz® vibrotactile feedback system. In other embodiments, different messaging devices and haptic feedback systems may be utilized.

[0029] The illustrative messaging device comprises a display, a speaker, a network interface, a memory, and a processor in communication with each of these elements. The illustrative messaging device also comprises a touch-sensitive interface and an actuator, both of which are in communication with the processor. The touch-sensitive interface is configured to sense a user's interaction with the messaging device, and the actuator is configured to output a haptic effect. The illustrative messaging device may further comprise a manipulandum configured to detect a user interaction and transmit an interface signal associated with the user interaction to the processor.

[0030] In the illustrative messaging device, the display is configured to display a graphical user interface to the user. The graphical user interface may comprise virtual objects, for example icons, buttons, or a virtual keyboard. The illustrative messaging device further comprises a touch-sensitive interface, such as a touch-screen, mounted overtop of the display. The touch-sensitive interface allows the user to interact with the virtual objects displayed in the graphical user interface. For example, in one embodiment, the graphical user interface may comprise a virtual keyboard, and in such an embodiment, the touch-sensitive interface allows the user to touch a key on the virtual keyboard to input the alphanumeric character associated with the key. This functionality may be used to type messages, or otherwise interact with objects in the graphical user interface.

[0031] In the illustrative messaging device the processor is configured to determine a haptic effect and transmit a haptic signal corresponding to the haptic effect to an actuator configured to output the haptic effect. In the illustrative messaging device, this haptic effect simulates a texture that the user feels on the surface of the touch-sensitive interface. The simulated texture may be associated with the user interface shown on the display. For example, the display may show an icon comprising the shape of a rock. In such an embodiment, the processor may determine a haptic effect configured to simulate the texture of the rock on the surface of the touch-sensitive interface. Then, the processor will transmit a haptic signal to an actuator configured to output the haptic effect. When the actuator receives the haptic signal, it will output a haptic effect, such as a vibration, at a frequency configured to cause the surface of the touch-sensitive interface to approximate the texture of the rock.

[0032] In the illustrative embodiment, the processor may implement a haptic map to determine the haptic effect. For example, in the illustrative embodiment, the processor may receive a display signal comprising a plurality of pixels, each of the pixels associated with a color. For example, in the illustrative embodiment, each pixel in the display signal may be associated with the color red, green, or blue, and it may further be associated with an intensity for each color. In the illustrative embodiment, the processor will assign a haptic value to each color and further assign a haptic intensity associated with the intensity of each color. Then, the processor will transmit a haptic signal comprising the haptic values and haptic intensities to an actuator configured to output the haptic effect.

[0033] In the illustrative embodiment, the processor may further determine the haptic effect based on an external trigger. For example, in the illustrative embodiment, the processor is configured to receive an interface signal from a touch-sensitive interface configured to detect a user interaction. Then, in the illustrative embodiment, the processor will determine the haptic effect based at least in part on the interface signal. For example, the processor may modify the haptic value or haptic intensity based at least in part on the interface signal. In the illustrative embodiment, if the touch-sensitive interface detects a high speed or high pressure user interaction, the processor will determine a higher intensity haptic effect.

[0034] The illustrative messaging device may output a haptic effect for a multitude of purposes. For example, in one embodiment, the haptic effect may act as a confirmation that the processor has received an interface signal associated with a user interaction. For example, the graphical user interface may comprise a button, and the touch-sensitive interface may detect user interaction associated with pressing the button and transmit an interface signal to the processor. In response, the processor may determine a haptic effect to confirm receiving the interface signal. In such an embodiment, the haptic effect may cause the user to feel a texture on the surface of the touch-sensitive interface. In the illustrative embodiment, the processor may further determine haptic effects for other purposes. For example, the illustrative messaging device may output a texture to alert the user to boundaries on the display or as an identification for objects such as icons on the surface of the display.

[0035] This illustrative example is given to introduce the reader to the general subject matter discussed herein. The invention is not limited to this example. The following sections describe various additional non-limiting embodiments and examples of systems and methods for a texture engine.

Illustrated System for a Texture Engine

[0036] Referring now to the drawings in which like numerals indicate like elements throughout the several figures, FIG. **1** is a block diagram of a system for a texture engine according to one embodiment of the present invention. As shown in FIG. **1**, the system **100** comprises a messaging device **102**, such as a mobile phone, portable digital assistant (PDA), portable media player, portable computer, portable gaming device, or some other mobile device. In some embodiments, messaging device **102** may comprise a laptop, tablet, desktop PC, or other similar device. In still other embodiments, the messaging device may comprise an external monitor for use with a PC or some other device. The messaging device **102** comprises a processor **110** in communication with a network