which responds to pulse **1012** to produce haptic output pulse **1022**. Haptic output pulse **1022** resembles a transient impulse response and includes medium frequency components (e.g., 30 Hz). The actual medium frequency components produced are dependant on characteristics of the haptic actuator and pulse **1012** as would be appreciated. Haptic output pulse **1022** may be used to simulate a force effect during which a user of handheld device **800** experiences a sharp haptic effect of substantially limited duration (e.g., on the order of 70 ms). Such force effects are characterized as a contact force. Haptic output pulse **1022** may typically provide up to 8 g's of force or more for various gaming impacts.

[0054] FIG. **11** illustrates various internal views of a handheld device **1100** similar to device **800** of FIG. **8** and capable of providing various haptic effects in accordance with an embodiment of the present invention. FIG. **12** illustrates various internal views of a handheld device **1200** similar to device **800** of FIG. **8** and capable of providing various haptic effects in accordance with an embodiment of the present invention. FIG. **13** illustrates various internal views of a handheld device **1300** similar to device **800** of FIG. **8** and capable of providing various haptic effects in accordance with an embodiment of the present invention. In each of these illustrative embodiments, the handheld device includes one or more haptic actuators, including a force effect actuator and a deformation effect actuator. In each of these embodiments, the force effect actuator includes a motor **1110** that drives an eccentric rotating mass ("ERM") **1112**. In other embodiments, other types of actuators such as piezo or SMA based actuators can be used instead of the motor/ERM. The actual force effects that are produced by the force effect actuator depend on, for example, a mass of ERM **1112**, a distance between its center of mass and axis of rotation, a size and rotational speed of motor **1110**, and other characteristics of motor **1110** and ERM **1112**. In some embodiments, one or more of the characteristics may be adjustable or controllable such that the force effect actuator may be tuned or controllably modified during operation.

[0055] FIG. **11** is now used to describe a deformation effect actuator in accordance with one embodiment of the invention. Device **1100** includes a DC motor mounted to a single-stage gearbox that drives a cam. The deformation effect actuator includes one or more deforming mechanisms **1120**, a motor **1130**, a gear **1140** and a cam **1150**. Motor **1130** drives gear **1140** and cam **1150**. Cam **1150** engages with deforming mechanism **1120** and forces them to expand. In some embodiments, a spring or similar bias device may be used to contract deforming mechanisms **1120**. In some embodiments of the invention, deforming mechanisms **1120** provide the haptic effect directly to the user. In some embodiments of the invention, deforming mechanisms **1120** engages a deformable portion **1160** of a housing of handheld device **800** (e.g., a rubber housing) which provides the haptic effect to the user. As illustrated, handheld device **1100** includes a disengaged state **1170** where no deformation effect is provided to the user and an engaged state **1180** where a deformation effect is provided to the user. In some embodiments, various degrees of deformation effect may be provided depending on a shape and size of cam **1150** as would be appreciated. In some embodiments, the deformation effect may be provided to either or both sides of handheld device **1100**.

[0056] FIG. **12** is now used to describe a deformation effect actuator in accordance with one embodiment of the invention. Device **1200** includes a multistage gearbox/motor assembly. The deformation effect actuator includes one or more deforming mechanisms **1220**, a motor **1250**, a drive gear **1240** and deforming gears **1230**. Motor **1250** drives drive gear **1240**. Drive gear **1240** engages with each of deforming gears **1230**. Deforming gears **1230** are coupled to deforming mechanisms **1220** and are configured to expand and/or contract deforming mechanisms **1220**. In some embodiments of the invention, deforming mechanisms **1220** provide the haptic effect directly to the user. In some embodiments of the invention, deforming mechanisms **1220** engage a deformable portion **1160** of a housing of handheld device **800** which provides the haptic effect to the user. As illustrated, handheld device **1200** includes a disengaged state **1170** where no deformation effect is provided to the user and an engaged state **1180** where a deformation effect is provided to the user. In some embodiments, various degrees of deformation effect may be provided to the user as would be appreciated. In some embodiments, the deformation effect may be provided to either or both sides of handheld device **1200**.

[0057] FIG. **13** is now used to describe a deformation effect actuator in accordance with one embodiment of the invention. Device **1300** includes solenoid based actuation. The deformation effect actuator includes one or more deforming mechanisms **1320**, a piston or linear drive or solenoid **1350**, and a slide **1340**. Linear drive **1350** drives slide **1340** back and forth between a disengaged state **1170** and an engaged state **1180**. In the engaged state, linear drive **1350** drives slide **1340** forward which causes slide **1340** to engage with deforming mechanisms **1320** and expand them. In some embodiments of the invention, interior surfaces of deforming mechanisms **1320** may taper inwardly from a maximum distance near linear drive **1350** to a minimum distance at an extent of linear drive **1350** thereby providing increasing expansion of deforming mechanisms **1320** as slide **1340** is driven forward. In some embodiments of the invention, deforming mechanisms **1220** provide the haptic effect directly to the user. In some embodiments of the invention, deforming mechanisms **1220** engage a deformable portion **1160** of a housing of handheld device **1300** which provides the haptic effect to the user. In some embodiments, the deformation effect may be provided to either or both sides of handheld device **1300**.

[0058] FIG. **14** is a block diagram of a deformation effect device in accordance with one embodiment of the invention. Device **1400**, which may be a game controller device, has affixed to its outside surface one or more piezoelectric material based actuators **1410**. Each actuator **1410** includes a substrate **1430** and piezoelectric material **1420**. In an "off" state at **1475**, the piezoelectric material **1420** is approximately flush against the substrate. In an "on" state at **1485**, when current or an actuation signal is applied to the actuator, piezoelectric material **1420** will bow outwards. The bowing can be felt by a user's fingers that are contacting the piezoelectric material. In another embodiment, a rubber or other type of housing can cover actuators **1410**. In one embodiment, the piezoelectric material may be Macro Fiber Composite ("MFC") material from Smart Material Corp., or may be any monolithic or composite piezo. Device **1400** may also include an internal force effect actuator as previously described.

[0059] FIG. **15** is a perspective view of a game controller **1500** in accordance with one embodiment of the invention. Game controller **1500**, similar the devices shown in FIG. **4**, changes shape on its side in response to specific events in a video game. As shown in FIG. **15**, at Time A, various shapes **1510** are formed on the side of controller **1500** to indicate, for