ACCELEROMETER MODULE FOR USE WITH A TOUCH SENSITIVE DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the use of touch pads and touch screens.

2. Description of the Related Art

An accelerometer is a device for measuring acceleration. Acceleration is the sum total of external forces acting on an object divided by the mass. Accelerometers are perhaps the simplest Micro Electro-Mechanical System (MEMS) device possible, sometimes consisting of little more than a suspended cantilevered beam or proof mass with some type of deflection sensing and circuitry.

Accelerometers can be used to measure vibration on cars, machines, buildings, process control systems and safety installations. They can also be used to measure seismic activity, inclination, machine vibration, dynamic distance and speed with or without the influence of gravity. Applications for accelerometers that measure gravity, wherein an accelerometer is specifically configured for use in gravimetry, are called gravimeters.

Accelerometers are being incorporated into more and more personal electronic devices such as media players and handheld gaming devices. In particular, more and more smartphones (such as Apple's iPhone) are incorporating accelerometers for step counters, user interface control, and switching between portrait and landscape modes.

Accelerometers are used along with gyroscopes in inertial guidance systems, as well as in many other scientific and engineering systems. One of the most common uses for MEMS accelerometers is in airbag deployment systems for modern automobiles. In this case the accelerometers are used to detect the rapid negative acceleration of the vehicle to determine when a collision has occurred and the severity of the collision.

Although accelerometers have found widespread acceptance and utility, the functionality of the accelerometer must be designed and manufactured into the original equipment. There is no existing solution that allows accelerometer functionality to be added to an existing electronic device. It would be desirable to have a module that would provide an existing electronic device with the ability of sensing acceleration. It would be even more desirable if the module was simple, quick to install, and compatible with common portable electronic devices.

SUMMARY OF THE INVENTION

One embodiment of the invention provides an apparatus for sensing acceleration. The apparatus comprises a mobile electronic device having a touch sensitive device, such as a touch pad or touch screen, that provides input to a processor, and a module selectively securable to the mobile electronic device adjacent the touch sensitive device. The module includes one or more acceleration-responsive mechanisms, wherein each acceleration-responsive mechanism has a deformable member that contacts the touch screen over a contact area that varies in response to acceleration. Optionally, the module may include three acceleration-responsive mechanisms, wherein each acceleration-responsive mechanism detects acceleration in a different axis of a Cartesian coordinate system. The deformable member is made of material that can be sensed by the touch device.

Another embodiment of the invention provides a method of sensing acceleration. The method comprises disposing a deformable member adjacent a touch sensitive device surface, directing a force of acceleration to push the deformable member against the touch sensitive device surface to cause elastic deformation of the deformable member, and sensing a change in the contact area between the deformable member and the touch sensitive device as a result of the elastic deformation.

A further embodiment of the invention provides a computer program product embodied on a computer readable medium and providing computer usable instructions for sensing acceleration. The computer program product comprises instructions for detecting a change in the contact area of a first touch sensitive device region associated with acceleration along a first coordinate axis, instructions for detecting a change in the contact area of a second touch sensitive device region associated with acceleration along a second coordinate axis, instructions for detecting a change in the contact area of a third touch sensitive device region associated with acceleration along a third coordinate axis, and instructions for determining an overall acceleration as the combination of the acceleration along the first coordinate axis, acceleration along a second coordinate axis, and acceleration along a third coordinate axis.

Other embodiments, aspects, and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of a mobile phone having a touch screen.

FIG. **2** is a block diagram showing the components of the mobile phone.

FIG. **3** is plan view of a mobile phone touch screen in accelerometer mode.

FIG. **4** is a perspective view of an accelerometer module being coupled to the mobile phone.

FIG. **5** is a plan view of the accelerometer module coupled to the mobile phone.

FIG. **6** is a cross-sectional view of the accelerometer module coupled to the mobile phone.

FIGS. **7**A-B are partial cross-sectional views of a first mechanism for measuring the force of acceleration in a "Z" direction with a deformable ball in relaxed contact with the touch screen and deformed contact with the touch screen, respectively.

FIGS. **8**A-C are partial cross-sectional views of a second mechanism for measuring acceleration in an "X" direction with a deformable ball in slightly deformed contact under a spring force, greatly deformed contact, and in relaxed contact, respectively.

FIGS. **9**A-D are side views of deformable members that would provide different relationships between acceleration and contact area.

FIG. **10** is a partial perspective view showing a spring that biases a lever to prevent loose swinging of the lever and maintain contact between the deformable member and the touch screen.

FIGS. **11**A-B are partial cross-sectional views showing potential attachment of a deformable member to a lever.

FIGS. **12**A-B are partial cross-sectional views of a third mechanism for measuring the force of acceleration in a "Z" direction with a deformable ball in relaxed contact with the touch screen and deformed contact with the touch screen, respectively.