

one or more of a substantially circular motion, a substantially linear motion, at least one substantially circular motion in combination with at least one substantially linear motion, at least one of a substantially circular motion and a substantially linear motion in combination with a period of substantially no motion, a substantially curved motion and a tapping motion. For a case where the user-manipulated physical object is comprised of at least two fingers of the user, the motion may comprise movement of one finger relative to at least one other finger. The data recorded may be descriptive of at least one of a velocity and an acceleration of the user-manipulated physical object. For the case where the user-manipulated physical object is comprised of at least one finger of the user, the data recorded may be descriptive of at least a shape assumed by the at least one finger.

[0101] Various modifications and adaptations may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings and the appended claims. As but some examples, the use of other similar or equivalent user input devices and technologies maybe employed, such as resistive and/or capacitive-based touch pad or screen devices, as may other gestures and commands be attempted by those skilled in the art. However, all such and similar modifications of the teachings of this invention will still fall within the scope of this invention.

[0102] Further by example, the exemplary embodiments of this invention may provide an initial user training session where the user enters the same gesture several times when prompted by the program **18A** in order to train the gesture recognition process to the particular finger motions and/or velocities, and possibly the finger tip size, that are characteristic of the user. This can be useful for, as an example, establishing the specific threshold or thresholds used by the gesture recognition processes.

[0103] Further by example, and for the two-dimensional embodiments of FIGS. **8-10**, an actual touching of the surface of the display **52** may not be necessary if there is sufficient ambient lighting so that the finger tip image can be acquired even when the finger tip is not actually in contact with the surface of the display device. In this case the finger or finger tip image may be acquired optically within the three dimensional space in the vicinity of the device **50**.

[0104] Still further, in some embodiments the UST system of FIGS. **1-7** may be used in the same device in conjunction with the hand, finger or finger tip image embodiments of FIGS. **8-10**, and at any given time information derived from one or the other, or both, may be used for gesture recognition. In general, two or more similar or different object sensing technologies may be used together in the same device.

[0105] It can be noted that in the various illustrative embodiments of this invention that were described above the DP **16** may perform substantially all of the required processing, based on program instructions contained in the program **18A** stored in the memory **18**. However, it is also within the scope of the exemplary embodiments to perform at least some of the processing in the image acquisition system or subsystem itself, such as in the ultrasonic-based imaging system of FIGS. **1-7** or in the optical-based imaging system of FIGS. **8-10**. For example, the actual image generation processing may be performed in the imaging system by a local embedded data processor, and the results may be

passed to and processed by the DP **16** for performing the gesture recognition and interpretation operations.

[0106] Further, it may be appreciated that certain hand/finger gestures may be defined to have a standardized and universal meaning across different devices, applications and languages. One non-limiting example may be the index finger and thumb formed into a circle, with the remaining three fingers extended (an OK gesture), which may interpreted universally as, for example, "save and close a file". The use of the exemplary embodiments of this invention facilitates this type of operation.

[0107] In general, it may be appreciated that an aspect of the exemplary embodiments of this invention is a method, a computer program product and an apparatus that are responsive to a user executing a gesture with a user-manipulated physical object in the vicinity of a device to generate data that is descriptive of the presence of the user-manipulated physical object when executing the gesture and to interpret the data as pertaining to at least one object.

[0108] As employed herein the "presence of the user-manipulated physical object" may include, but need not be limited to, the spatial orientation of the user-manipulated physical object in two or three dimensional space, the repose of the user-manipulated physical object in two or three dimensional space, a shape formed by the user-manipulated physical object in two or three dimensional space, the motion being made by the user-manipulated physical object in two or three dimensional space, the velocity of the user-manipulated physical object in two or three dimensional space, the acceleration of the user-manipulated physical object in two or three dimensional space, and combinations thereof.

[0109] For example, the patterns traced by the user's fingertip when executing the gestures shown in FIG. **8A** for the clockwise and counterclockwise fingertip motions may be identical (i.e., a circle or oval), however the two gestures are distinguishable one from the other by the sensing of the direction of the fingertip motion in real or substantially real time.

[0110] Note further that both fixed and scanning type sensors may be used, such as UST systems/components that scan an ultrasonic beam through the environment.

[0111] Furthermore, some of the features of the examples of this invention may be used to advantage without the corresponding use of other features. As such, the foregoing description should be considered as merely illustrative of the principles, teachings, examples and exemplary embodiments of this invention, and not in limitation thereof.

What is claimed is:

1. A method, comprising:
 - executing a gesture with a user-manipulated physical object in the vicinity of a device;
 - generating data that is descriptive of the presence of the user-manipulated object when executing the gesture; and
 - interpreting the data as pertaining to at least one object displayed by the device.
2. The method of claim 1, where the user-manipulated physical object is comprised of at least one finger of a user.
3. The method of claim 1, where generating data generates data that is descriptive of motion being made by the user-manipulated object in three dimensional space.