acoustic signals are recorded. Processor **404** processes the resulting time-stamped signals to produce commands that control an electronic device.

[**0053**] One skilled in the art will recognize that the various components of **FIG. 4** are presented as functional elements that may be implemented in hardware, software, or any combination thereof. For example, synchronizer **403** and processor **404** could be different software elements running on the same computer, or they could be separate hardware units. Physically, the entire apparatus of **FIG. 4** could be packaged into a single unit, or sensors **401** and **402** could be separate, located at different positions. Connections among the components of **FIG. 4** may be implemented through cables or wireless connections. The components of **FIG. 4** are described below in more detail and according to various embodiments.

[**0054**] Referring now to **FIG. 5**, there is shown an embodiment of optical sensor **401**. Optical sensor **401** may employ an electronic camera **506**, including lens **501** and detector matrix **502**, which operate according to well known techniques of image capture. Camera **506** sends signals to frame grabber **503**, which outputs black-and-white or color images, either as an analog signal or as a stream of digital information. If the camera output is analog, an analog-to-digital converter **520** can be used optionally. In one embodiment, frame grabber **503** further includes frame buffer **521** for temporarily storing converted images, and control unit **522** for controlling the operation of A/D converter **520** and frame buffer **521**.

[**0055**] Alternatively, optical sensor **401** may be implemented as any device that uses light to collect information about a scene. For instance, it may be implemented as a three-dimensional sensor, which computes the distance to points or objects in the world by measuring the time of flight of light, stereo triangulation from a pair or a set of cameras, laser range finding, structured light, or by any other means. The information output by such a three-dimensional device is often called a depth map.

[**0056**] Optical sensor **401**, in one embodiment, outputs images or depth maps as visual information **505**, either at a fixed or variable frame rate, or whenever instructed to do so by processor **404**. Frame sync clock **804**, which may be any clock signal provided according to well-known techniques, controls the frame rate at which frame grabber **503** captures information from matrix **502** to be transmitted as visual information **505**.

[**0057**] In some circumstances, it may be useful to vary the frame rate over time. For instance, sensor **401** could be in a stand-by mode when little action is detected in the scene. In this mode, the camera acquires images with low frequency, perhaps to save power. As soon as an object or some interesting action is detected, the frame rate may be increased, in order to gather more detailed information about the events of interest.

[**0058**] One skilled in the art will recognize that the particular architecture and components shown in **FIG. 5** are merely exemplary of a particular mode of image or depth map acquisition, and that optical sensor **401** can include any circuitry or mechanisms for capturing and transmitting images or depth maps to synchronizer **403** and processor **404**. Such components may include, for example, signal conversion circuits, such as analog to digital converters, bus interfaces, buffers for temporary data storage, video cards, and the like.

[**0059**] Referring now to **FIG. 6**, there is shown an embodiment of acoustic sensor **402**. Acoustic sensor **402** includes transducer **103** that converts pressure waves or vibrations into electric signals, according to techniques that are well known in the art. In one embodiment, transducer **103** is an acoustic transducer such as a microphone, although one skilled in the art will recognize that transducer **103** may be implemented as a piezoelectric converter or other device for generating electric signals based on vibrations or sound.

[**0060**] In one embodiment, where taps on surface **50** are to be detected, transducer **103** is placed in intimate contact with surface **50**, so that transducer **103** can better detect vibrations carried by surface **50** without excessive interference from other sounds carried by air. In one embodiment, transducer **103** is placed at or near the middle of the wider edge of surface **50**. The placement of acoustic transducer **103** may also depend upon the location of camera **506** or upon other considerations and requirements.

[**0061**] Referring now to **FIG. 7**, there is shown one example of locations of transducer **103** and optical sensor **401** with respect to projected keyboard **70**, for a device such as PDA **106**. One skilled in the art will recognize that other locations and placements of these various components may be used. In one embodiment, multiple transducers **103** are used, in order to further improve sound collection.

[**0062**] Referring again to **FIG. 6**, acoustic sensor **402** further includes additional components for processing sound or vibration signals for use by synchronizer **403** and processor **404**. Amplifier **601** amplifies the signal received by transducer **103**. Low-pass filter (LPF) **602** filters the signal to remove extraneous high-frequency components. Analog-to-digital converter **603** converts the analog signal to a digital sound information signal **604** that is provided to synchronizer **403**. In one embodiment, converter **603** generates a series of digital packets, determined by the frame rate defined by sync clock **504**. The components shown in **FIG. 6**, which operate according to well known techniques and principles of signal amplification, filtering, and processing, are merely exemplary of one implementation of sensor **402**. Additional components, such as signal conversion circuits, bus interfaces, buffers, sound cards, and the like, may also be included.

[**0063**] Referring now to **FIG. 8**, there is shown an embodiment of synchronizer **403** according to one embodiment. Synchronizer **403** provides functionality for determining and enforcing temporal relationships between optical and acoustic signals. Synchronizer **403** may be implemented as a software component or a hardware component. In one embodiment, synchronizer **403** is implemented as a circuit that includes electronic master clock **803**, which generates numbered pulses at regular time intervals. Each pulse is associated with a time stamp, which in one embodiment is a progressive number that measures the number of oscillations of clock **803** starting from some point in time. Alternatively, time stamps may identify points in time by some other mechanism or scheme. In another embodiment, the time stamp indicates the number of image frames or the number of sound samples captured since some initial point in time. Since image frames are usually grabbed less fre-