CAPACITIVE TOUCH DETECTORS

FIELD OF THE INVENTION

[0001] The present invention relates to capacitive touch operated devices.

BACKGROUND TO THE INVENTION

[0002] There has been general satisfaction with what has been provided heretofore in this field. However, we, as inventors of the present invention, have done considerable research and determined that there are a number of areas in which there could be substantial improvement. We have isolated the following areas in particular.

[0003] 1 Sensitivity to radio interference

[0004] 2 Sensitivity to static impulses

[0005] 3 The inability to distinguish a large touch object at a great distance from a small touch object at a small distance. (For example, to distinguish the tip of a finger from the bulk of a human hand—known hereafter as the palm effect.

[0006] 4 A generally low signal to noise ratio in the fundamental sensing, which tends to exhibit itself as slow response to a touch.

[0007] 5 An inability to synthesise information from multiple sensors.

[0008] A previous patent (Bach: GB 2,250,822 B=WO 90/14604) has described a method of creating a buffered sensor utilising a frequency variable Schmitt trigger based oscillator. This arrangement has certain advantages in its simplicity of construction but we have appreciated that it suffers from oscillator lockup if presented with interference near its frequency or operation (i.e. it locks on to the interfering frequency), and that filtering is difficult to implement as the device works on a wideband FM principle and its operating range is between 100 KHz and 500 KHz.

[0009] A previous patent (Pepper: U.S. Pat. No. 4,371,746) relates to a sensing surface and an adjacent buffered surface detecting a touch through a thin insulating layer of glass. This adjacent buffer driven in sympathy with the signal of interest has many advantages particularly when used to scan arrays of sensors.

[0010] These two patents relate to improvements in construction, electronic sensor technology, the algorithms employed in determining touch and some novel arrangements of sensors to create new forms of touch-operated media capable of being used in a variety of applications.

[0011] A previous patent (Bach: GB 2,25,720 B=WO 92/08947) relates to a device for determining the presence and/or characteristics of an object or substance, and comprises capacitive means the capacitance of which is changed due to the presence and/or characteristic of the object or substance. The device also includes a circuit arrangement for detecting the change in capacitance, which includes a fixed frequency oscillator, the amplitude, output and/or phase of which is dependent on the change in capacitance.

[0012] An application for a UK patent (Applicant, Moonstone Technology Ltd; Inventor, Tagg: GB 9410281.1 on 20 May 1994, published number *) has been made relating to a through glass audio device which can be used in conjunction with these improvements to generate an information system with audio and tactile feedback.

[0013] The disclosure of the aforementioned patents and applications provides applications of, all possible combinations of features thereof with, and background explanation for, the present invention, and is accordingly hereby imported into the present specification.

[0014] Capacitive sensors can be constructed using the technology described by patent 2,250,822 B. However we have appreciated that these proposals suffer from a number of problems: particularly, static sensitivity and frequency lockup. Furthermore, we have appreciated that a means of multiplexing a number of channels is required without the multiplexing element reducing the sensitivity of the channel by loading it. Previous patent applications have described a way of organising a set of buffered multiplexers but we have appreciated that these proposals suffer from a number of inherent flaws including limited fan out (ability to drive many sensor pads or make connections thereto) and the incorrect driving of multiplexer chips which results in inconsistent performance from one component to the next. These effects are particularly pronounced when large pads need to be driven at the end of long, high capacitance wires.

[0015] The aforementioned documents do not refer to the actual action of touching. The prior patent documents cited, U.S. Pat. Nos. 5,172,065, 5,214,388 and EP-A-0428502, refer to proximity sensors which are not suitable for detecting a touch per se.

[0016] The Present Invention

[0017] According to respective aspects of the present invention, there are provided detectors having the respective features defined in the accompanying claims and in following Points 1-32:

[0018] 1. A capacitive touch detector, which comprises means to improve selectivity.

[0019] 2. A detector, which comprises a narrow band buffer.

[0020] 3. A detector, wherein means for reducing the effect of noise comprise capacitive coupling of the buffer into the detector.

[0021] 4. A detector, which comprises a plurality of sensor pads of different inherent capacitances and means to approximate impedances which include said capacitances.

[0022] 5. A detector, which comprises circuitry comprising said impedances and adapted to operate at respective frequencies to approximate the impedances.

[0023] 6. A detector, wherein said impedances comprise components having respective resistances to approximate the impedances.

[0024] 7. A detector, which comprises a plurality of sensor pads and at least two multiplexers arranged in series to lower capacitance loading of the sensor pads.

[0025] 8. A detector, which comprises a plurality of sensor pads and a synchronous demodulator