The invention relates to capacitive sensors for sensing the presence or touch of an object adjacent to a sensor. Capacitive position sensors have recently become increasingly common and accepted in human interfaces and for machine control. For example, in the fields of portable media players it is now quite common to find capacitive touch controls operable through glass or plastic panels. Some mobile (cellular) telephones are also starting to implement these kinds of interfaces.

Many capacitive touch controls incorporated into consumer electronic devices or appliances provide audio and/or visual feedback to a user indicating whether a finger or other pointing object is present or approaches such touch controls. A capacitive sensing microprocessor may typically be comprised in touch-controlled devices which are arranged to provide an "on" output signal when a finger is adjacent to a sensor and an "off" output signal when a finger is not adjacent to a sensor. The signals are sent to a device controller to implement a required function dependent on whether a user's finger is in proximity with or touching an associated touch control.

Some touch-controlled devices remain "on" or "active" despite the user having moved away from the device or a particular function no longer being required. This results in the device consuming a large amount of power which is not efficient. There is a need for an improved capacitive touch sensor which can regulate power usage.

According to a first aspect of the present invention, there is provided a sensor for determining the presence of an object comprising: a sensing element, a capacitance measurement circuit operable to measure the capacitance of the sensing element, and a control circuit operable to determine whether an object is in proximity with the sensor based on a measurement of the capacitance of the sensing element, the control circuit also being operable to provide an output signal to control a function of an apparatus based on an object not being in proximity with the sensor and the output signal being produced after a predetermined time duration.

According to a second aspect of the invention, there is provided an apparatus comprising a sensor according to the first aspect of the invention.

The invention is described in further detail in Section 3.5 of the datasheet.

The control circuit of the sensor can determine whether an object or a user's finger is no longer in proximity with the sensor and based on a pre-determined time duration, the control circuit can produce an output signal automatically to prevent the capacitance measurement circuit from continually measuring changes in capacitance due to, for example, the perceived presence of an object in proximity with the sensor. Therefore, the control circuit is able to deactivate, turn-off, or power down the capacitance measurement circuit where an apparatus has inadvertently been left on or with the erroneous perception that a user is still present. The capacitance measurement circuit and the control circuit may be comprised in a general-purpose microcontroller under firmware control.

As described in Section 3.5 in conjunction with the drawings, the control circuit of the sensor may be implemented by different methods – the signal output may be produced automatically after different pre-determined time durations to effect powering down the capacitance measurement circuit due to no presence of the user; the control circuit may be programmed by a user so that it may power down an apparatus based on a user-selected time duration; the control circuit output signals may be overridden, for example, to extend time durations before an apparatus is turned-off or to immediately turn-off an apparatus when a user is no longer present.

The sensor of the invention may be useful in various applications, for example in kitchen appliances, light switches, headsets, and other electronic consumer devices. For example, a coffee machine incorporating a sensor of the invention may be programmed to power-down after a time period of, say, 30 minutes, where the coffee machine has been left on inadvertently. This will beneficially conserve energy use and minimise the possibility of damage and/or accidents caused by the coffee machine or glass container(s) overheating.

The sensor of the invention may comprise different capacitance measurement circuits. For example, the fundamental principles underlying this type of sensor are as described in US 5, 730,165 and US 6,466,036. A sensor of the invention is described in detail in the QT102 product datasheet produced by QRG Ltd. (trading as Quantum Research Group). The sensor described in the QT102 datasheet may be used in apparatus or devices with one touch key; off course, the sensing element of the sensor

of the invention may comprise more than one key, for example two, three, or more keys. The sensor may also be based on other capacitance measuring techniques, such as described in US 6,452,514.

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	QAO
	Application Number	
Title of Invention	Proximity Sensor with Auto-Off Function	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
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Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

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Applicant 1 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kevin		Snoad	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Chichester	Country Of Residence[i]	GB
Citizenship under 37 CFR 1.41(b)[i]	GB		

Mailing Address of Applicant:

Address 1	QRG Ltd.,		
Address 2	1 Mitchell Point, Ensign Way		
City	Hamble, Southampton	State/Province	
Postal Code	SO31 4RF	Country[i]	GB

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Application Information:

Title of the Invention	Proximity Sensor with Auto-Off Function		
Attorney Docket Number	QAO	Small Entity Status Claimed	☒
Application Type	Provisional		
Subject Matter	Utility		
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	QAO
	Application Number	
Title of Invention	Proximity Sensor with Auto-Off Function	

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐	**Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S. C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Prior Application Status			Remove
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