TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

24th October 2014

1. WIRELESS PRESSURE SENSOR USES RADIO WAVES TO MONITOR PRESSURE

Pressure sensing enables wide variety of applications ranging from industrial applications to biomedical applications. In biomedical applications, pressure sensing is used, for example, to detect brain trauma. The current method to detect brain pressure is through intracranial pressure (ICP) monitoring. This method involves penetrating the skull and using a probe, which is connected externally to the monitor. As the probes are inserted inside the brain, there is risk of infection. This method is also challenging for the patient. There is a need for a wireless device, which can measure the pressure inside the brain. The device should be small in size; be cost-efficient, and should also provide accurate results.

To address the above challenge, researchers from Stanford University have developed a very thin wireless pressure sensor that can be used to detect brain trauma. The sensor is comprised of two copper strips printed on a flexible substrate and thin layer of rubber. Rubber is used in the device to act as an insulator. The two copper strips are the electrodes of the pressure sensor, and act as radio antennae. The thin layer of the pyramid-shaped rubber is sandwiched between two strips of copper. The radio signal is sent to the device, and the wireless sensor starts to resonate at the particular initial resonant frequency. When the pressure is exerted on the device, copper antenna sticks to the rubber insulator. The frequency of the radio waves passing through the antenna is slowed down. Thus changes in pressure alter the electric characteristic of the device. As soon as the pressure is released, the copper antenna is moved apart from the rubber and accelerates the frequency of radio waves. Thus, the pressure is measured by tracking the frequency of radio

waves. Because of its simple and robust design, this sensor is very cost efficient allowing it to be used in several applications.

Once the project is fully developed, it will be used as a tool to detect brain trauma. It will also be used to measure a pulse by attaching a sensor to the radial artery of the hand. Researchers are planning to deduce a way to integrate the device into the eye socket to measure pressure. Pressure inside the eye socket is relatively easy to measure with the help of the device. And this pressure further helps to keep track of intracranial pressure on the brain. It will also be used in tracking packages, measuring weight or monitoring air or liquid pressure. In future it will also be used in prosthetic devices to sense the pressure.

The project was self-funded by Stanford University and supported by the Stanford School of Medicine. The researchers are currently working on advancing the applications of pressure sensing technology. The project is expected to be commercialized in one to two years' time. Once the project is fully developed, it has opportunties to get a good response from the biomedical industry.

Details: Zhenan Bao, Professor, Chemical Engineering, Stanford University 450 Serra Mall, Stanford, CA 94305-2004. Phone: 650-723-2419. E-mail: zbao@stanford.edu. URL: http://www.stanford.edu/

2. MULTITOUCH SURFACE FOR RECOGNIZING GESTURES

In recent years, there has been an upsurge in the development of multi-touch and gesture enabled technologies. With the evolution of smart phones and tablets, the use of multi-touch technology has become more ubiquitous. Computer keyboards, mouse, and automatic speech recognition (ASR) software have been traditionally used to communicate with computers. The challenge is to shuffle between the mouse and keyboard in order to enter commands. Two-dimensional (2D) or three-dimensional (3D) motion sensing and gesture recognition technologies are available in the market. While 2D systems sensing lacks the capability to accurately sense motion and interpret information, 3D systems can require the user to provide gestures in the air, making it uncomfortable for users during long time usage. Hence, there is a need for development of gesture recognition devices, which could accurately receive

input provided by the user in a more comfortable and a convenient manner. The device should be easy to use and also be cost-efficient.

To address the above need, researchers from Singapore-based Ractiv Inc., have developed a device called Touch+. Touch+ could provide multi-touch capabilities on any surface. Touch+ is comprised of light-emitting diodes (LEDs), two video graphics array (VGA) cameras with gesture sensing, and a special software processing system to distinguish the activity of each finger.

Touch+ is provided with a double-sided USB plug. The device is integrated with LEDs. LEDs give the added feature and the capability to be used even in the absence of ambient light. The device's two VGA cameras have the capability to work within a short range. The cameras can track the motion of two hands. The cameras can also be used as Webcams. Touch+ uses a special software processing system to distinguish the activity of each finger. This software helps to increase the efficiency of the device and also reduces unwanted gesture recognition.

Touch+ brings the multi-touch experience to devices that are not typically touch-enabled, such as computers and TVs; hence enhancing usage experience as simple as using a smart tablet. Since Touch+ is a relatively new product, it will have a great impact in the consumer electronics industry. The product can also be expected to be incorporated in developing smart televisions and in the automobile industry in the future. The cost efficiency is one of the distinctive features of the device; it will help to increase the product value proposition amongst customers.

The project was funded by National Research Foundation, Singapore; and Red Dot Ventures. Ractiv’s novel Touch+ device offers significant advantages such as ease of use, accuracy, compatibility, and compactness. Touch+ has opportunities to stir the consumer electronics industry due to its functionality.

Details: Lai Xue, Co-Founder, CTO, Ractiv Inc., San Francisco, California. Phone: 864-977-1123. E-mail: lai@ractiv.com. URL: http://www.ractiv.com/

3. PYROELECTRIC INFRARED SENSING

Infrared sensing has applications in various sectors, such as, gas sensing, spectroscopy, temperature sensing, flame detection, and presence detection/ occupancy sensing. Growth applications of infrared sensing include gesture control in consumer electronics, and building automation. Infrared

sensors are typically of two types--cooled sensors or uncooled sensors. Both types of infrared sensors have challenges. While cooled sensors are expensive devices and require cryogenic cooling, uncooled pyroelectric infrared sensing can lack a fast response, which can be important in applications such as gas sensing, spectroscopy, and flame detection. Hence, there is a need for a cost-efficient, easy to use, and fast responsive sensing device.

To address the above challenge, Germany-based InfraTec Inc., has been able to address the challenges with its pyroelectric technology that is able to deliver high responsiveness at competitive price points.

InfraTec infrared sensing technology is based on complementary metal oxide semiconductor (CMOS). To achieve a stable operating point, the company also uses a built in thermal circuit. It helps the device to achieve stability in critical applications. InfraTec is able to attain permanent polarization of the material. Without permanent polarization, the material drifts back to its normal state and hence requires re-calibration. The two major aspects of innovation in InfraTec technology include the usage of junction field effect transistor (JFET) and permanently polarized material. These properties enable InfraTec to achieve higher signal gain and faster time response.

Infrared sensing has applications in various established industries, as well as, emerging fields. While InfraTec's passive infrared sensors are targeted primarily at gas and flame detection, industrial touchless sensing, occupancy detection, and motion sensing are other important applications. Emerging applications for InfraTec technology include touchless gesture control for consumer electronics. The technology is able to cover a wide range of the electromagnetic spectrum that includes the entire infrared, visible, and ultraviolet frequencies.

InfraTec has been able to address key challenges that can be faced by uncooled pyroelectric infrared sensors, such as low responsiveness and high cost. The company has developed a core technology that hasf application in various industries. InfraTec has broadened its applications scope with new product developments.

Details: Ian Goldsbrough, Sales Manager, InfraTec Infrared Ltd., Chesterfield, UK. Phone: 01-813-9715001. E-mail: i.goldsbrough@infratec.co.uk. URL: http://www.infratec.com.

4. RECENT PATENTS IN THE FIELD OF INFRARED GAS SENSING

Gas sensors are employed to prevent exposure of humans to fire or toxic substances. Gas sensors are of various types and have a wide array of applications. Advanced gas sensing devices are multifunctional and are capable of detecting more than one gas. Applications for infrared gas sensors include industrial safety, breweries/fermentation, HVAC (heating, ventilation, and air conditioning)/indoor air quality, and healthcare.

A recent patent in infrared gas sensing (WO/2014/112392) is assigned to Panasonic Intellectual Property Management Co. Ltd. It relates to pyroelectric element and substrate. Another patent refers for to an infrared sensors for detecting carbon dioxide.

From 1959 to September 2014, approximately 506345 patents have been registered under gas sensing. During September to October 2014, approximately 700 patents have been registered under gas sensing. From 1990 to July 2014, approximately 139 patents has been registered under infrared gas sensing. The trend in 2014 suggests that infrared gas sensors have a strong demand from different industries such as building, oil and gas, chemicals, and so on. An increase in safety regulations has acted as a demand driver for infrared gas sensors.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Infrared detection element, infrared detector, and infrared type gas sensor	24.07.2014; WO/2014/112392	Panasonic Intellectual Property Management Co., Ltd.	Watabe, Yoshifumi	This infrared detection element is obtained by forming a first pyroelectric element and a second pyroelectric element side by side on one pyroelectric substrate. The first pyroelectric element is provided with a first front surface electrode, a first back surface electrode, and a first portion that is a portion of the pyroelectric substrate sandwiched between the first front surface electrode and the first back surface electrode. The second pyroelectric element is provided with a second front surface electrode, a second back surface electrode, and a second portion that is a portion of the pyroelectric substrate sandwiched between the second front surface electrode and the second back surface electrode. The pyroelectric substrate is provided with a slit, which follows the outer periphery of the first pyroelectric element, in a region that surrounds the first pyroelectric element so that the slit avoids a first front surface wiring line and a first back surface wiring line. A region of the pyroelectric substrate surrounding the second pyroelectric element is continuous all around the second portion. This infrared detector is provided with an infrared detection element. This infrared type gas sensor is provided with an infrared radiation element and an infrared detection element.
Apparatus for measuring concentration of smoke in chimney-discharge gas by using infrared sensor	24.07.2014; WO/2014/112691	Park, Jeong-hwan	Park, Jeong-hwan	A smart card usable in magnetic stripe swipe transactions with a transaction terminal configured to read transaction information encoded on a magnetic stripe of a standard transaction card includes a card body, which includes a magnetic stripe emulator for use with the transaction terminal, a smart card chip programmed with at least one transaction application for providing secured data for use in a transaction and dynamic card verification data, a power supply, and a card controller in communication with the magnetic stripe emulator. The card controller is configured to receive the dynamic card verification data and control the magnetic stripe emulator to emit a magnetic field encoded with at least a portion of the secured data and the dynamic card verification data.
Nondispersive infrared (NDIR) CO2 gas sensor	20.02.2014; CN103884671	China Jiliang University	Chen Hongyan	The invention discloses a CO2 gas sensor based on a nondispersive infrared method (NDIR). The CO2 gas sensor mainly comprises a circuit board and a gas chamber structure, wherein a circuit part comprises a light source driving circuit, a detector circuit and a main control board circuit; a gas chamber structure part is composed of a gas inlet chamber, a film coating gas chamber and a gas outlet chamber, the gas inlet chamber is provided with a spotlight cup by which a light source is emitted in a parallel beam manner, and the influence caused by infrared light of an undesired wave band and an external infrared ray entering a detector is eliminated through a diaphragm; grooves of the gas inlet chamber and the gas outlet chamber are internally provided with four sealing rings, the sealing rings can guarantee that indoor gas and the outside world are isolated, meanwhile, light filters are respectively fixed in the gas inlet chamber and the gas outlet chamber, and the film coating gas chamber, the gas inlet chamber and the gas outlet chamber are connected and fixed, so that central axes of the film coating gas chamber, the gas inlet chamber and the gas outlet chamber are consistent. The CO2 gas sensor disclosed by the invention has the advantages that the structure is simple and compact, the disassembly and cleaning are easy, the environmental disturbance is reduced as far as possible, the optical energy use ratio is improved, and the detection precision of the sensor is guaranteed.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Infrared gas sensor a nd detecting method thereof	18.06.2014; CN103868877	Liu Yongping	Liu Yongping	The invention provides an infrared gas sensor and a detecting method thereof in order to overcome the defects of a traditional mining infrared gas sensor. The sensor comprises a shell, an inner barrel, a circuit module, a light source, an infrared detector, a temperature sensor, a filter membrane, a metal mesh and a vent plate, wherein the light source is used for periodically radiating light waves after being modulated, the light waves irradiate the infrared detector after being absorbed by gas to be detected, and an electric signal modulated to have the same period with the light source is extracted through filtration and amplification. The infrared gas sensor is used for detecting the concentration of the gas to be detected under a measuring mode and calibrating equipment under a calibration mode. The infrared gas sensor has the beneficial effects of stably and reliably operating in a severe environment for a long term and having anti-explosion performance; a breathable air chamber is formed under the heating of the light waves periodically radiated by the light source, and is integrated with an optical system, so that the concentration of a plurality of gases can be simultaneously detected; in addition, the measuring and calibrating methods are simple and reliable.
Light path deflection-based double-light-path single-sensor gas infrared d etection system and method	18.06.2014; CN103868855	Xi'an Jiaotong University	Tang Xiaojun	The invention discloses a light path deflection-based double-light-path single-sensor gas infrared detection system and method. The system comprises an infrared light source, a reference gas chamber, a detection gas chamber, a deflection reflector, an infrared photoelectric detector and a deflection device. The deflection device drives the light source or a reflector to generate deflection, so that light paths are switched between the reference gas chamber and the detection gas chamber and reach the infrared detector in a time-sharing mode; the infrared detector compares the intensity of detected light signals twice, takes a common logarithm of the ratio of the two light signals as a detection signal and converts the detection signal into gas concentration through polynomial fitting according to a calibration sample. By adoption of the infrared sensor, the influence brought by light source drift is eliminated, and the influence brought by characteristic drift of the sensor also can be eliminated.
Optical structure of small-size NDIR (non-dispersive infrared) type gas sensor	28.05.2014; CN103822891	Wuxi CAS Intelligent AgriculturaL Development Co. Ltd.	Tao Chunhui	A wireless smart card having a personal area network transceiver, such as a Bluetooth transceiver, to couple the wireless smart card with a mobile communication device, and a near field communication (NFC) and radio-frequency identification (RFID) transceiver to couple the wireless smart card to a wireless transaction device, and a transponder with a secure element to allow secure communications between the mobile communication device with the wireless smart card and the wireless smart card and the wireless transaction device is described. The wireless smart card allows, for example, contactless payment through a Bluetooth-enabled mobile communication device without modification to the mobile communication device.
Infrared gas sensor	28.05.2014; CN103822892	Jiangsu IOT Research Development Center	Zhang Wenbo	The invention discloses an infrared gas sensor which adopts a cylindrical structure, wherein the cylindrical structure comprises a first region between an inner side wall and an outer side wall, a second region formed by the inner side wall in a surrounding manner, a top wall and a bottom wall, wherein gas inlet and outlet are formed in the top wall and/or the bottom wall; the first region comprises a first sub long-light path passage and a first sub short-light path passage; the second region comprises a partition board extending from the top wall to the bottom wall, and is divided into a second sub long-light path passage and a second sub short-light path passage by the partition board; the top wall comprises a reflection part which is used for respectively reflecting light emitted by the first sub long-light path passage and the first sub short-light path passage to the second sub long-light path passage and the second sub short-light path passage. According to the invention, the dimension of the infrared gas sensor is reduced, and the reliability and the stability of the infrared gas sensor are improved.

Exhibit 1 lists some of the patents related to infrared gas sensing.

Picture Credit: Frost & Sullivan

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