TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

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1. TEMPERATURE SENSOR ENABLED BY CARBON NANOTUBES AND TOBACCO CELLS

There are ongoing needs in temperature sensing for high accurate temperature sensors, including those capable of providing accurate readings at higher temperatures, that are also cost-effective. Furthermore, heat sensitive (thermal imaging) cameras form images using infrared radiation. Sensors that provided higher resolution would enable more detailed thermal images.

To address such challenges, researchers from ETH Zurich have devised a unique technique to develop a highly sensitive temperature sensor. The researchers haved the sensor as Cyberwood.

The highly sensitive temperature sensor consists of electrically conductive tiny carbon nanotubes (CNTs) and tobacco cells that are combined to constitute a hybrid biosynthetic material. Tobacco cells are employed because they can detect and respond to the smallest change in temperature, leading to a change in the cells' conductivity. These cells conduct electricity better when the temperature in their surrounding increases. The tobacco cell comprises a type of sugar molecules known as pectins, which play a key role in sensitivity of the cells to temperature. The sugar molecule forms a gel, which also comprises calcium and magnesium ions. Pectin is cross linked with the charged atoms. When the temperature increases, pectin breaks the link between atoms and the gel becomes soft, further helping the ions to move freely. In their experiments, the ETH Zurich researchers used tiny tubes of carbon to grow the tobacco cells. The electrically conductive CNTs were arranged to form a network with tobacco cells. After drying the CNTs, a firm woody structure was formed. The woody structure is highly conductive because of the CNTs. Even inside the CNTs, the tobacco cells retain their characteristics

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of being highly conductive and sensitive, enhancing the ability of the material to respond to temperature changes. This biosynthetic material-based sensor responds to changes in temperature with hundred times more accuracy than the existing sensors. The sensor can identify warm bodies, such as a hand approaching the sensor, at a distance of few centimeters, a feature that can enable multiple applications in different industries. The conductivity of the sensor is dependent on the distance of the hand from the sensor.

For example, Cyberwood can be used to develop a screen that will react to the movement of gestures sensing the heat signals from the body, which can be further integrated in a television or a mobile phone. It can also be employed to develop heat sensitive cameras to watch for intrusion into restricted areas. Cyberwood can be integrated into night vision devices and can be highly useful for military operations. In addition, Cyberwood can also be used in cars to detect pedestrians crossing streets in the dark. According to the researchers, this futuristic sensing technology will be efficient, accurate, and much cheaper than the conventional temperature sensors.

ETH Zurich collaborated with the University of Salerno (Italy) for this research. The researchers are working on identifying different applications for these temperature sensors. In addition, the researchers are also trying to create transparent and flexible temperature sensors. They are working toward developing a biocompatible and highly sensitivity temperature sensor based on the same technology.

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2. WIRELESS THUMBNAIL TRACK PAD

Wearable devices are gaining a lot of traction from various industries such as medical, consumer electronics, defense, and many more. Wearable sensing devices are finding expanding opportunities in connection with mobile phones or other consumer products. As an ever-increasing amount of data is accessed from mobile devices, there will be expanding opportunities for innovative ways of displaying and controlling devices while individuals are

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mobile. Sensors and flexible electronics are the key enablers of wearable devices.

Key challenges in the design of wearable sensing devices include space constraints, need for ultra low power, and applications requiring enhancements in user interface technologies. There is a need for small, cost-efficient devices that a user can wear anytime and anywhere without experiencing any pain.

Toward addressing the above-mentioned needs, researchers from Massachusetts Institute of Technology have developed a wearable device that converts the user's thumbnail into a wireless track pad. Researchers are calling the device NailO.

The various ingredients employed to develop NailO are a battery, a pack of capacitive sensors, and a special purpose chip that combines the functions of Bluetooth radio, microcontroller, and capacitive sensing. Additional software is used to deduce the signal received from the capacitive sensors. From the received data, noise is filtered out with the help of software. Initially, the sensor was developed by printing electrodes on the flexible polyester. At present, the researchers are using off-the-shelf sheet electrodes. The capacitive sensor will register the touch of the user, the microcontroller will deduce the input signal, and with the help of Bluetooth, the device will be connected to the cell phone. The device is not energy efficient, so when the device is not in use, the user will have to deactivate the device to save power.

In the future, NailO has opportunities to enable a wide range of applications, from mobile phone to control of household appliances, such as turning them on or off. The NailO could also be used with television sets and in the gaming sector as a console to send the input signal to the other devices. The device can be easily accessed by other fingers; and can be used to control many devices in the future, such as inside the car for controlling the air conditioner, music system, and navigation device. The device is very easy to use and comfortable to wear for a long time as the thumbnail does not have any nerve and the user will not experience any pain after wearing the device.

The project was self-funded by Massachusetts Institute of Technology. At present, researchers are identifying different applications of the device. In addition, the researchers are also working towards identifying a technology to improve the battery life. They are also planning to reduce the size of the device.

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In future, the device will also take audio-based inputs from human touch and can also be expected to integrate the vibration sensor.

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3. SMART PIR SENSOR FOR SMART HOME APPLICATIONS

Homes are made smarter by having motion detection capabilities to enhance their security systems.

Passive infrared (PIR) sensors detect a difference in temperature and thermal radiation in the environment caused by a person or animal. PIR motion detectors can have limitations, such as limited range, insensitivity to very slow motion, temperature limitations.

In addition, motion detectors may not provide full coverage of the home or even of a particular room, which further affects the communication between motion detector and a receiver at the users end. Thus, there is a need for a device that can provide enhanced communication capabilities and full home coverage, with low power requirement. In addition, the device should be cost efficient as well as easy to use and integrate into smart home solutions.

To address the above-mentioned challenges, Netherlands-based GreenPeak Technologies has developed a smart passive infra-red (PIR) sensor for indoor motion detection for smart home applications.

The passive infrared motion sensor features three important capabilities--coverage of full room, low cost, and most importantly, a long battery life. The passive infrared motion sensor is based on the GreenPeak GP490 Zigbee communication chip. For achieving full home coverage and an enhanced range for motion sensing, along with wireless capabilities, GreenPeak Technologies has used its antenna diversity mechanism. The motion detector is capable of identifying false alarms that may be inadvertently triggered, for example, by pets or kids. GreenPeak Technologies has enabled wireless capabilities in PIR motion detection with the help of the ZigBee communication mechanism. Another component of the PIR sensor is a software tool called IDE debugger, which will help to collect the information, analyze the data, and trigger the

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alarm. The smart PIR motion detector has opportunities to provide a cost-effective and enhanced motion detection solution.

Smart home sensor solutions are converging with cloud services and social media, which further helps in decoding and analyzing the data. At present, GreenPeak Technologies' smart home solutions are in the third phase of development, which comprises a cloud integrated small data management system using sensors that perform multiple operations. In addition, the sensors are integrated with some advanced capabilities, such as, self-learning and data analytics. GreenPeak Technologies' passive infrared sensors are expected to be commercialized by the third quarter of 2015.

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4. RECENT PATENTS IN THE FIELD OF OPTOELECTRONIC SENSORS

In optoelectronic sensors, the electrical output is proportional to the amount of light (such as, visible, infrared, and ultraviolet) incident on the device's active area. Optoelectronic sensors can be used for various applications such as in healthcare, industrial,defense/homeland security, consumer electronics, among others.

Optoelectronic sensors can converge with various technologies, such as image sensing, robotics, energy harvesting, and nanostructured materials. Sensing light has various applications in automation, imaging, security, and surveillance. Optoelectronic sensors have been finding expanding market potential.

Ambient light sensors and image sensors are gaining considerably wider acceptance in consumer electronics devices. Optoelectronic sensors are heavily used for security and surveillance applications, including night vision, law enforcement, and firefighting. These sensors are also used for environmental sensing. Typical industrial applications for optoelectronic sensors include machine vision, object detection, proximity sensing, color sensing. Sensors are used to enable automation, and also for quality checking of products and packaging.

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Most number of patents has been published on image sensors. For optoelectronics sensors, North America represents the largest market.

A recent patent in optoelectronics sensing (EP 2833161), assigned to Valeo Schalter & Sensoren GmbH, pertains to an optical measurement device for motor vehicles that has a scanning optoelectronic detection device, and also to a scanning sensor.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Optoelectronic measuring device for a motor vehicle and scan sensor for the same	04.02.2015; EP2833161	VALEO SCHALTER & SENSOREN GMBH	KIEHN MICHAEL	The invention relates to an optical measurement device for a motor vehicle having at least a scanning opto-electronic detection device. The invention also relates to a scanning sensor for such an optical measuring device. In order to provide an optical measuring apparatus for a motor vehicle, which requires as little space for mounting on a motor vehicle 1, the optical elements of one or more transmitting and receiving combinations of the optoelectronic detection device in a structurally separate from the electronic elements scan sensor 2, 3 are according to the invention arranged and connected to the respective associated electronic elements via optical conductor 8.
METHOD FOR OPERATING AN OPTOELECTRONIC PROXIMITY SENSOR	29.01.2015; WO/2015/011094	OSRAM OPTO SEMICONDUCTORS GMBH	HALBRITTER, Hubert	The invention relates to a method for operating an optoelectronic proximity sensor (1), wherein the proximity sensor (1) comprises a radiation-emitting component (2), a radiation-detecting component (3) and a control unit (4), the radiation-emitting component (2) is operated by means of a pulsed current (Ie), during a measurement period (Tm) the pulsed current (Ie) of the radiation-emitting component (2) has in each case an on-time (ton) and an off-time (toff), wherein the pulsed current (Ie) has a pulse current intensity (Ion) during the on-time (ton), and the control unit (4) evaluates a detector signal (Id) of the radiation-detecting component (3) and lowers the pulse current intensity (Ion) for a subsequent measurement period (Tm), when the detector signal (Id) exceeds a threshold value (Ith) during at least one measurement period (Tm).
Optoelectronic sensor and method for detecting objects	21.01.2015; EP2827173	SICK AG	NÜBLING RALF ULRICH	It an optoelectronic sensor (10) for detecting objects in a monitoring region (18) is provided, in particular a laser scanner having a light transmitter (12) for emitting a transmitted light beam (16), a light receiver (26) for generating a received signal from that of Objects in the surveillance area (18) of the remitted light (20), a receiving optical system (22, 24) with at least one receiving lens (22) for focusing the reflected light (20) onto the light receiver (26), an about a rotational axis (34) movable optical unit (32), in the light transmitter (12) and light receiver (26) together with the optical receiving system (22, 24) are housed for periodic scanning of the monitored area (18), as well as an evaluation unit (28, 42) for detecting information about objects in the monitoring area (18) on the basis of the received signal. In this case, the receiving optical system (22, 24) additionally on a beam shaping mirror element (24).
CLOTHES WASHING MACHINE, SUSPENSION ASSEMBLY AND OPTOELECTRONIC WEIGHT SENSOR	26.03.2015; WO/2015/039466	WUXI LITTLE SWAN CO., LTD.	HUANG, Shengye	An optoelectronic weight sensor for use in a clothes washing machine, a suspension assembly for use in same and a clothes washing machine. The optoelectronic weight sensor (30) for use in a clothes washing machine comprises: a lower housing (320), and an upper housing (310) which is vertically movably connected to said lower housing (320); a light-emitting terminal (340) and a light-reception terminal (350) are separately arranged on the lower surface of the upper housing (310) or on the upper surface of the lower housing (320); a light-reflecting stage (360) is arranged on the upper surface of the lower housing (320) or on the lower surface of the upper housing (310), and opposite to the light-emitting terminal (340) and the light-reception terminal (350); first elastic components (330) are separately arranged between the lower housing (320) and the upper housing (310); second elastic components (331) are separately arranged between the lower housing (320) and the upper housing (310) in such a way as permanently to push the upper housing (310) away from the lower housing (320).

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Optoelectronic sensor	10.12.2014; EP2811318	SICK AG	PIRKL KLAUS	The invention relates to an optoelectronic sensor for monitoring a monitoring area, having at least one light transmitter for the transmission of light signals into the monitored zone, at least one light receiver for receiving light coming from the monitoring area, and a least one light receiver associated with the control means to display a menu , The optoelectronic sensor is characterized in that the control device is designed to recognize gestures in the monitoring area and to be interpreted as signals that trigger a navigation and / or taxes in the menu.
OPTOELECTRONIC SENSOR FOR RECOGNIZING OBJECT EDGES	13.11.2014; US20140333939	SICK AG	MERETTIG Gerhard	An optoelectronic sensor for recognizing object edges of objects comprises at least three light transmitters which are arranged such that at least two different spacings result between two respective light transmitters. For recognizing an object edge, an evaluation unit is configured to carry out a common evaluation of an image taken by a light receiver of a light spot generated by the transmitted light beams of a first light transmitter and of an image taken by a light receiver of a light spot generated by the transmitted light beams of another light transmitter. The pair of light transmitters to be used for the common evaluation can be selected in dependence on a selection criterion from at least two differently spaced apart pairs of light transmitters.
Optoelectronic fill level sensor	27.08.2014; EP2770308	SICK AG	SONNTAG DENNIS	It is an opto-electronic liquid level sensor (12) provided for determining a filling level of a medium (12) in a container (14), wherein the filling level sensor (10) at least one light transmitter (20) for emitting a transmitted light beam (18) in the direction of the medium (12) and at least one light receiver (30) for generating a received signal from within said container (14) thrown back light (28) and an evaluation unit (30) which is adapted, from the received signal by means of a light transit time method the respective distance of the level sensor (10) to determine to several measurement points in the vessel (14). In this case, (16) the evaluation unit (30) is further adapted to carry out an evaluation of the distances at the measuring points a direct reflection (36) on a surface of the medium (12) and / or a container reflection on the container (14) to identify and to determine the filling level based on the direct reflection (36) and / or the container reflection.

Exhibit 1 lists some of the patents related to optoelectronics sensors.

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