TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

12th December 2014

1. SENSORS ENABLING ENERGY SAVING PLATFORM

In United States, energy consumed by the residential and commercial buildings is seen as a major challenge to energy efficiency. According to the US Department of Energy (DOE), approximately 40% of energy is consumed by the building. To address the issues for energy consumption in buildings, the first generation of solutions were manually operated. These solutions led to very large inefficiencies. The second generation of solutions was automated, requiring no human control. However, these solutions led to discomfort for the employees because they has to wear sweaters to work and wave their arms in order to turn the lights on. There is a need for a third generation solution that can enable buildings achieve energy efficiency and is also designed to ensure the comfort of the employee. The solution should be easy to use, cost-effective and accurate.

To address the above-mentioned challenge, researchers from California-based company, Enlighted Inc., have developed an energy saving platform. This platform consists of four different units—sensor unit, gateway, energy manager, and real-time data solution provider.

The sensor unit in the energy saving platform is deployed with light sensor, temperature sensor, and motion sensor. Only one smart sensor unit is deployed per fixture. Temperature sensor is employed to monitor the heat or the coldness in the rooms, which further help to give a clear picture of the thermal profile of a building. Motion sensor is deployed to track the presence of people in a room. Gateway is the channel between energy manager and the smart sensors. The gateway is deployed to gather data wirelessly from individual sensors and send a command and update the individual sensors. The sensors provide energy data and occupancy, temperature, and ambient light

statuses. The energy manager is employed to collect data, analyze the data and provide the reporting of the data collected by the sensors. In addition, the energy manager, through various peripherals and ports, can share the data with the third party system. With the help of energy manager, the user can adjust settings by creating profiles of the entire lighting control system.

Although Enlighted's technology is deployed for energy conservation and efficiency purposes, the same data can be used for varied applications. The lighting, heating and cooling plates of the system can be used for facilities management, which will further help to determine information about the rooms, such as, the availability of the conference room and use them in a more efficient way. It can also be used in retail settings to give information, such as, how well the promotions are working, where the people are gathered from the sales point of view, and to find an effective way for traffic flow.

Enlighted has commercialized the product under the Global Energy Optimization program. Researchers are currently working on connecting the network of sensors with mobile applications. The current customers of Enlighted are Google, LinkedIn, and Starbucks, among many others. Enlighted is planning to integrate its sensor network with Philips LED drivers. In the office lighting market, approximately 70% of the shares is acquired by Philips. Enlighted is getting a good feedback from its customers because it helping to drive down the energy cost and is cost effective.

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2. SENSOR-ENABLED FITNESS TRACKING DEVICE

According to the Centers for Disease Control and Prevention, every year, approximately 600,000 people die because of heart disease in United Sates. And approximately 720,000 people every year in United States get a heart attack. People are taking precautions and measures to avoid these instances. Different technologies available in the market also help individuals to track their health. However, these devices may not be accurate or cost efficient. There is a need for a device that can help the user to measure heart rate and pulse rate automatically with high accuracy. The device should be easy to use and cost effective.

To address the above-mentioned need, researchers from OSRAM Opto Semiconductors, based in Germany, have developed an automatic fitness tracking device (SFH 7050) enabled with an optical sensor. The optical sensor is integrated with built-in emitters, light-emitting diode (LED), and photodiode.

The emitters embedded in the automatic fitness tracking device are developed with the help of thin-film chip technology. The thin film has a spectral narrow bandwidth of approximately 30 nm and works on different wavelengths such as 940 nm, 660 nm and 530 nm. The thin-film emitter is employed to provide reliable measurement with high signal quality and also helps to save power. The photodiode is employed in the automatic fitness tracking device because of characteristics such as good signal-to-noise ratio, and high linearity. The emitter is deployed to measure oxygen in the blood at the fingertip and pulse at the wrist. The emitter enabled with green LED is used to measure the pulse at wrist and the emitter enabled with red LED is used to measure the oxygen in the blood at fingertips. The SFH 7050 sensor is thus used to track fitness automatically.

Once the project is successfully commercialized, it will be embedded in smart watches or armbands. This device will be further used for pulse rate measurement and heart rate. The device will be very useful for heart patients. Researchers are also planning to upgrade the device by integrating infrared LED. It will be further employed to be used as proximity sensor in combination with the photodiode. It will start the measurement automatically as soon as the sensor touches the skin and stop the measurement when the sensor is removed from the skin. The automatic tracking device developed by OSRAM Opto Semiconductors is very easy to use and cost-effective. These qualities will further boost the demand for the automatic tracking device.

The project was fully funded by OSRAM Opto Semiconductors. Researchers are currently working on enabling the device for the different applications. Once the device is successfully commercialized, it can be expected to get a good response from end users for continuously monitoring their health in real time. Rutronik will be the supplier for the automatic fitness tracking device.

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3. MULTI-PARAMETER SENSING DEVICE FOR HEALTH AND FITNESS TRACKING

Health and wellness is a megatrend that is transforming the way consumers are keeping track of their fitness levels as well as health. Various health and fitness tracking devices have emerged in the recent past, which are targeted toward this megatrend. Consumer electronics companies are also showing a lot of interest in this growing trend, which is evident by the prominence of such products displayed at the recent Consumer Electronics Shows (CES). Primarily, the health and fitness trackers are wearable devices that can function independently or in collaboration with a smartphone or a tablet. However, certain challenges exist that include inconvenience of use, issues with maintenance, and possible lack of multi-parameter sensing capabilities. Moreover, drawing meaningful analysis from collected data is also considered as an area of improvement.

Singapore-based Zensorium, has developed a fitness tracker that addresses the aforementioned challenges in its innovative product, Tinké. Using reflective optical sensing technology the device is able to gather photoplethysmogram (PPG) waveforms when the user places his/her finger on a designated spot on the device. Using this input multiple parameters such as heart rate, respiratory rate, blood oxygen saturation, and heart rate variability are calculated. The device basically consists of sensors for collecting information, signal processing, and software for analysis and data visualization. The infrared light emitted from the LED (light-emitting diode) source is reflected onto the skin of the user and is recorded by a sensor. These two components, the light source and light detector, are placed on the same plane, which provides an accurate reading. The amount of reflected ray is directly dependent on the blood volume in the capillary of the finger, which in turn is an indication of the various parameters measured by Tinké. The major challenge in this type of technology is the interference caused by ambient light that enters a finger through the fingernail and reaches the sensor's light detector. To overcome this challenge, Zensorium has developed an advanced signal processing algorithm, which filters noise and provides accurate readings. The Tinké device comes with a downloadable app for smartphones, where detailed analysis about the user’s health and wellness is charted out. Zensorium also provides users with easy to interpret scores on Zen and Vita Index of the user, which provides an

understanding of health and wellness. The Vita index is created using data gathered from heart rate, blood oxygen level and respiratory rate. It provides indication about the user's fitness level, at a glance. The Zen index indicates the user's level of relaxation by analysing data from controlled breathing for a minute.

Tinké comes in two versions, one for iPhone users, and the other compatible with android phones. Even though the basic functionality is the same for such operating systems, the form factor and operation varies. Tinké can be directly plugged in to the iPhone whereas for android, the device is connected using Bluetooth. Tinké has extremely user friendly dimensions, which allow it to be easily carried along, without the user having to wear it on the body. Although the version for android phones is slightly bigger than the one for iPhones, the maximum dimension is still only 70 mm. The device is also ultralightweight; the android version weighs 23 gm while the iPhone version weighs less than 11 gm. The smaller size for the iPhone version can be attributed to the fact that it does not require a battery to operate. The device draws power from the iPhone itself.

Zensorium already has customers for Tinké in over 30 countries around the world. Its competitively pricing, capability of multi-parameter sensing, maintenance-free use, and small form factor are key success factors for the device.

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4. RECENT PATENTS IN THE FIELD OF INFRARED SENSING

Infrared (IR) sensors are non-contact devices capable of emitting and/or receiving infrared waves in the form of heat. Infrared sensing is enabling various applications, such as spectroscopy, thermal imaging, security and surveillance, flame detection, gas detection (for exapmple, detection of carbon dioxide or hydrocarbons), hyperspectral imaging, water analysis, and petroleum exploration. Gesture control in consumer electronics and building automation are the emerging and expanding applications of infrared sensing. Another new area is smart phones equipped with thermal imaging cameras. Passive infrared

sensors are mainly classified into two types, that is, thermal infrared sensors (which absorb IR radiation and undergo a change in temperature) and quantum infrared sensors.

A recent patent in infrared sensing (WO/2014/193184), assigned to JPK Korea Co. Ltd., pertains to an infrared communication sensor and motion sensor to turn the lighting modules on or off. The motion sensor senses the motion of the person or a vehicle. Qualcomm has a patent (WO/2014/188906) on a near infrared sensor for palpation (use of hands to examine the body) for measuring oxygen concentration with minimum effects on palpation performance.

From 1967 to December 2014, approximately 2700 patents have been registered under infrared sensing. In 2014, approximately 96 patents have been registered under infrared sensing.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
INFRARED COMMUNICATION SENSOR AND MOTION SENSOR NETWORK SYSTEM AND METHOD FOR LIGHTING IN GROUP UNITS BY USING SAME	04.12.2014; WO/2014/193184	JPK KOREA CO., LTD.	KIM, Seok Tae	A motion sensor network method for lighting in group units by using an infrared communication sensor according to the present invention comprises the steps of: sensing a first motion of a person or a vehicle by means of a first sensor module and turning on one lighting module; implementing infrared communication with another sensor module adjacent to the first sensor module and turning on another lighting module; maintaining the turning-on of the first lighting module and the other lighting module when the first sensor module or the other sensor module senses a second motion of the person or the vehicle; and turning off the first lighting module and the other lighting module when the first sensor module or the other sensor module fails to sense the second motion of the person or the vehicle for a certain time.
NEAR INFRARED OXYGEN CONCENTRATION SENSOR FOR PALPATION	27.11.2014; WO/2014/188906	QUALCOMM INCORPORATED	TARTZ, Robert Scott	Provided is an oxygen concentration sensor for palpation by which the contact of the sensor with a site to be measured is ensured so that the oxygen concentration (oxyhemoglobin concentration, deoxyhemoglobin concentration, degree of oxygen saturation, etc.) at the site can be surely measured, while minimizing effects on palpation performance. A near infrared oxygen concentration sensor (1) for palpation that is to be attached to the finger pad in the tip side of the first joint of a user's finger, said near infrared oxygen concentration sensor (1) comprising a base material (2) to be attached to the finger pad, a light-emitting means (4) which is formed on the base material and irradiates a target with light of at least two wavelengths including infrared light, light-receiving means (5a and 5b) which are formed on the base material and receive measurement light coming from a light-emitting device via the target, and a light-shielding means (3) which is positioned at least between the light-emitting means or the light-receiving means and the finger pad and prevents the measurement light coming via the user's finger to enter the light-receiving means, wherein the minimum distance between the light-emitting means and the light-receiving means is 3 mm or more and the maximum distance between the same is 15 mm or less.
CIRCULARLY POLARIZED LIGHT SEPARATION FILM, METHOD FOR PRODUCING CIRCULARLY POLARIZED LIGHT SEPARATION FILM, INFRARED SENSOR, AND SENSING SYSTEM AND SENSING METHOD UTILIZING LIGHT	13.11.2014; WO/2014/181799	FUJIFILM CORPORATION	ICHIHASHI Mitsuyoshi	The present invention provides: a circularly polarized light separation film which selectively allows transmission of right circularly polarized light or left circularly polarized light in at least a part of the near infrared wavelength range, and which contains a visible light blocking layer that reflects or absorbs light in at least a part of the visible wavelength range and a circularly polarized light separation layer that selectively allows transmission of right circularly polarized light or left circularly polarized light in at least a part of the near infrared wavelength range; a method for producing the circularly polarized light separation film; an infrared sensor which contains the circularly polarized light separation film; and a sensing system and a sensing method, each of which uses the circularly polarized light separation film or a combination of the circularly polarized light separation film and a film containing a visible light blocking layer. A sensing system and a sensing method according to the present invention have high sensitivity regardless of the surrounding environment and are reduced in erroneous detection.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
OVEN WITH INFRARED SENSOR	05.11.2014; EP2798272	ARÇELIK ANONIM SIRKETI	COSAN AHMET FERIT	The present invention relates to an oven (1) comprising an exterior body (2), a cooking cavity (3) wherein the cooking process is performed, a control unit (4), a door (5), an outer panel (6) forming the outer surface of the door (5) facing the user and produced from glass, an inner panel (7) having an air gap between the outer panel (6) and itself, forming the inner surface of the door (5) facing the cooking cavity (3), a front panel (8) located at the upper side of the door (5) and that protects the control unit (4), a fan (10) and an infrared sensor (13) that detects the infrared rays emitted from the foodstuff being cooked in the cooking cavity (3) to determine the outer surface temperature thereof and that has a converging lens (11) and a thermopile array (12). An opening is located at the upper side of the door and the infrared sensor is placed to the front panel with its lens facing the opening.
EXTRACTING TRUE COLOR FROM A COLOR AND INFRARED SENSOR	23.10.2014; WO/2014/172221	MICROSOFT CORPORATION	KANG, Sing Bing	The subject disclosure is directed towards color correcting for infrared (IR) components that are detected in the R, G, B parts of a sensor photosite. A calibration process determines true R, G, B based upon obtaining or estimating IR components in each photosite, such as by filtering techniques and/or using different IR lighting conditions. A set of tables or curves obtained via offline calibration model the correction data needed for online correction of an image.
INFRARED SENSOR OF REAR SURFACE IRRADIATION TYPE	18.09.2014; US20140264022	NOGUCHI Hidetaka	NOGUCHI Hidetaka	A rear-surface-irradiation-type infrared sensor includes a substrate having a through hole passing through between an upper surface and a lower surface; an infrared absorption part on the substrate on a side of the upper surface separate from the substrate by the through hole; and a temperature sensor part detecting a change in a temperature of the infrared absorption part. The through hole includes a first through hole part having an opening on the upper surface and one or more second through hole parts having shapes different from the first through hole constituent part. The first through hole part and the second through hole part(s) communicate with each other. In a cross-sectional shape of the through hole on a plane perpendicular to the upper surface, an inside wall of the first through hole part is outside an inside wall of the of second through hole part(s).
INFRARED SENSOR AND INFRARED SENSOR CHIP	18.09.2014; WO/2014/141824	OMRON CORPORATION	AITA, Fumiji	An infrared sensor (101) comprises: a semiconductor substrate having a recess in an upper surface; an upper-part surface having a sensor opening part (3) that is opened so as to correspond to the recess, the upper-part surface being formed on the upper side of the semiconductor substrate; and a sensor part (2) that transverses the second opening part (3) in an S shape while set at a distance from the inner surface of the recess so as to connect the space between a first location (61) and a second location (62) of the inner periphery of the sensor opening part (3). The sensor part (2) is sealed in a vacuum. A center part (4) of the sensor part (2) is disposed so as to be capable of receiving infrared light from an observed object. The sensor part (2) is provided with a thermoelectric conversion structure for converting a temperature difference between the center part (4) and the first location (61) and second location (62) into an electric signal.

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

Picture Credit: Frost & Sullivan

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