TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

27th June 2014

1. HANDHELD ORGANIC THREAT SCANNER USING X-RAYS

Homeland security deals with protecting a nation from various kinds of threats. Most of the threats, such as, drugs, ceramic knives, explosives, and contraband, are normally smuggled into countries across the border. It is important to have a detection system that is mobile and has a fast response time.

American Science and Engineering Inc. (United States) has developed a portable scanner that detects hidden organic threats using x-ray imaging technology. The technology named Z Backscatter involves capturing of x-rays that scatter from the objects. Organic matter has a high scattering factor and thus x-rays that scatter from these materials produce a bright image. This image can be used to detect organic threats. The portable scanner, known as Mini Z, has a very fast response time, which enables real-time scanning of objects. As the device is a handheld solution, it can be used anywhere with ease. Conventional x-ray scanning systems are bulky and immobile, which limit their usage. Other types of detectors such as density meters, portable transmission x-ray systems, and trace detectors are more complex to use and interpret the findings. The Mini Z system produces easy-to-interpret images that can swiftly detect organic threats, which are an area of growing concern to homeland security.

The device is safe for use by humans and to the environment. The x-ray dose emitted conforms to various radiation safety standards such as ANSI (American National Standards Institute), ICRP (International Commission on Radiological Protection), EURATOM (European Atomic Energy Community), and NCRP (National Council on Radiation Protection & Measurements). Though the system employs a low-energy and low-dose backscatter technology, it is not meant to be used to scan human subjects. The device does not require any set-up and thus enables immediate operation. An intuitive graphical user interface

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(GUI) allows the operator to initiate scanning and check the images in real time.

The most important achievement in this product has been the miniaturization of the components to enable a small form factor. The key application areas for the Mini Z include law enforcement, border security control, first responders, maritime police, as well as, general aviation security. The Mini Z can quickly screen unattended or suspicious baggage in public places to prevent terrorist attacks. In border security applications, the device can be potentially used for inspecting vehicles and goods to detect concealed threats or contraband substances. It can also be used to prevent threats from entering using the water channel, including, boats, and ships.

The Mini Z is touted as the first portable product based on the Z backscatter technology. The company plans to introduce a family of portable solutions using this technology. The device is expected to be adopted primarily in border security and also for public security check points.

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2. SENSING EXPLOSIVES WITH SILICON NANOWIRES

For civilian security and military needs, it is important to detect traces of explosives rapidly, selectively, sensitively, and reliably. Existing methods to detect explosives such as trinitrotoluene (TNT) can have certain drawbacks: they may be complex and could require a longer detection time, the devices can be bulky with high associated costs and the requirement for laboratory analysis, and susceptibility to false alarms. Pentaerythritol tetranitrate (PETN) is very powerful, nonvolatile, and commonly used explosive that hardly releases any molecule in the air, especially when it is hidden inside a container. Normally, trained sniffer dogs are used to detect explosives, but detection of PETN, even by these trained dogs, remains very difficult. There is a need for an efficient, small, reliable, handheld, and inexpensive instrument to detect these explosives.

In an effort to address the above-mentioned needs, researchers from Tel Aviv University and nanotechnology company Tracense in Israel have

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developed the prototype of a nanosensor that can be used to identify different types of explosives in real time. The device is comprised of silicon nanowires forming a nano-sized transistor, which is highly efficient in detecting a large variety of explosives.

The nanosensor prototype chip designed by Tel Aviv University consists of silicon nanowires that are used to form an electronic nose array to detect the explosives. To detect a variety of explosives with more efficiency and reliability, the chip is embedded with 200 individual sensors. The device is portable, easy to carry and handle, inexpensive and very efficient. It can detect explosives in real time and from a distance of up to about five meters from the source. This high range of detection makes it suitable to detect hidden explosives.

The researchers have tested this device with explosives used in commercial and military applications such as TNT and octogen (HMX). It was also used to detect peroxide-based explosives such as triacetone triperoxide (TATP) and hexamethylene triperoxide diamine (HMTD). The nanosensor works on the simple principle of electron transport chain. Silicon nano-field-effect transistors are rich with electrons. The nanowire binds the electron deficient molecule, such as TNT, through charge transfer donor acceptor interaction. This process helps to charge TNT and settle on the nanowire surface, causing rapid change in the conductance of electric sensing nano element. This phenomenon indicates presence of the explosive in the environment. The sensor can be used to detect explosives in solution, as well as, in the gas phase.

The research was funded by Tracense, which is looking for a strategic partnership with an established leader in the homeland security/ defense space. The research team from Tel Aviv University and Tracense is planning to develop its nanometirc sensor for biological and chemical detection as well. In the future, the sensors have the potential to be used to detect biological toxins such as botulinum, anthrax, and cholera.

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3. WEARABLE FLEXIBLE PILOERECTION MONITORING SENSOR

Piloerection, more commonly known as goose bumps, is a phenomenon related to erection of body hair. It is triggered by sudden changes in the body temperature or the emotional state of a person. Present skin piloerection sensing methods tend to have limitations in quantitative and objective measurement and can provide physical disturbance stimulation to the skin because of the heavy weight and bulky size of the measuring devices. Moreover, the brittle metallic conductive devices could stick to the skin and provide inaccurate results. There remains the need of a device which is biocompatible and flexible, while providing accurate measurement of piloerection.

Researchers from the Korea Advanced Institute of Science and Technology (KAIST) Daejeon, South Korea, have developed a wearable piloerection monitoring sensor addressing the above challenges. The device is comprised of flexible micro sensors that can be easily worn on the skin of the user. In the event of a piloerection, the capacitance of the sensor changes which forms as the basis of measurement of piloerection.

The wearable piloerection monitoring sensor developed by KAIST researchers consists of capacitors made of flexible conductive polymer PEDOT: PSS (poly(3,4-ethylenedioxythiophene) polystyrene sulfonate). It is transparent and highly conductive. The researchers used Ecoflex 0030 as the silicon substrate. This material is biocompatible with human skin and also exhibits high thermal and photo stability. This allows the embedded PEDOT: PSS polymer device to perform in diverse conditions. By using a multi-step spin coating process the researchers were able to embed the capacitors into the silicon substrate. The process gave the capacitors a coplanar structure with a spiral shape. A flexible printed circuit was used to transfer signals from the spiral coplanar capacitor to an external capacitance meter.

The researchers tested the working principle of piloerection monitoring sensor on a 28 year old male for real-time monitoring. Tests were conducted with sensor attached on the forearms and the subject was asked to hold ice cubes to induce a sudden shock. The attached sensor measured successive occurrence of goose bumps for 3.5 seconds and the simultaneous change in the capacitance. Positive capacitance change was measured when body hair touched the sensor as a result of piloerection.

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The wearable Sensor developed by KAIST was funded by the Ministry of Science and Future Planning, Korea. This device is expected to be commercialized circa early 2015. The researchers are currently working on reducing the size of signal processing system so that it can also be attached to the skin along with the actual sensor.

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4. RECENT PATENTS IN THE FIELD OF TOUCH SENSORS

Touch sensing technology is used as a user input interface in various kinds of devices. A most prominent, wide-scale application of touch sensors is in smart phones and tablets. However, touch sensors have been incorporated for various applications in consumer electronics, automotive, industrial controls, and so on.

The key technologies enabling touch sensing include capacitive, resistive, surface acoustic wave, and optical sensors. Capacitive technology is widely used and its proliferation can be attributed to the growing adoption of mobile computing devices.

The sensors are mainly glass based and film based. Glass based sensors are used when the touch sensors work in tandem with the display (touch screens). The next generation touch sensors are expected to incorporate nanowires that enable flexible sensors for applications such as flexible displays, wearable electronics, and so on. Patent no US20140028584, by Samsung Display Co., Ltd and patent no WO/2013/192437, by C3Nano Inc. pertain to the use of nanowires for touch sensing applications.

PATENT TITLE	PUBLICATION DATE / NUMBER	ASSIGNEE	INVENTORS	ABSTRACT
TOUCH-TYPE INPUT DEVICE	19.06.2014; WO/2014/092038	MURATA MANUFACTURING CO., LTD.	KITADA, Hiroaki	A touch-type input device (1) is provided with a touch sensor (10), an operation movement amount detection unit (12), a pressing force detection unit (13), and a control unit (20). The touch sensor (10) is provided with an electrostatic sensor (11C) and a piezoelectric sensor (11P), and

				outputs an operation position detection signal and a pressure detection signal. The operation movement amount detection unit (12) detects an operation movement amount from the operation position detection signal. The pressing force detection unit (13) detects a pressing force from the pressure detection signal. The control unit (20) sets a threshold value (Th) for the pressing force in advance, and initiates a drag operation when the pressing force is greater than or equal to the threshold value (Th). The threshold value (Th) is set to a value that is initially the maximum value, and decreases over time.
CAPACITIVE TOUCH KEYPAD ASSEMBLY	19.06.2014; WO/2014/093777	MASTER LOCK COMPANY LLC	JONELY, Michael B.	A capacitive touch keypad assembly includes a housing, a capacitance sensing substrate disposed within the housing, and a plurality of conducting members. The housing includes a barrier panel and a keypad display disposed on an exterior surface of the barrier panel. The keypad display defines a plurality of key locations each aligned with a corresponding bore in the barrier panel. The capacitance sensing substrate includes a plurality of key sensors in alignment with the corresponding plurality of key locations. Each of the plurality of conducting members has a first end disposed in a corresponding one of the plurality of barrier panel bores and a second end engaging a corresponding one of the plurality of key sensors.
WEARABLE MULTI-MODAL INPUT DEVICE FOR AUGMENTED REALITY	19.06.2014; WO/2014/093525	MICROSOFT CORPROATION	MARGOLIS, Jeffrey	A wrist-worn input device that is used in augmented reality (AR) operates in three modes of operation. In a first mode of operation, the input device is curved so that it may be worn on a user's wrist. A touch surface receives letters gestured or selections by the user. In a second mode of operation, the input device is flat and used as a touch surface for more complex single or multi-hand interactions. A sticker defining one or more locations on the touch surface that corresponds a user's input, such as a character,

				number or intended operation, may be affixed to the touch surface. The sticker may be interchanged with different stickers based on a mode of operation, user's preference and/or particular AR experience. In a third mode of operation, the input device receives biometric input from biometric sensors. The biometric input may provide contextual information in an AR experience while allowing the user to have their hands free.
TOUCH CONTROL SYSTEM AND SENSING METHOD THEREOF	12.06.2014; US20140159505	GIANTPLUS TECHNOLOGY CO., LTD.	PU Chia-Chuan	A touch control system and a sensing method thereof. Wherein, a plurality of sensor units are connected respectively to a control electrode line and a detection electrode line. Each sensor unit includes: a first switching element and a second switching element connected in parallel, and a sensing electrode connected to the second switching element. A common electrode provides a trigger signal to each sensing electrode to form coupling. The control electrode line is used to selectively output a turn-off signal in sequence to each of the first switching elements, so that the detection electrode line acts in cooperation with the sensor unit, in response to the turn-off signal. When a touch action occurs, the sensing electrode utilizes the detection electrode line to detect variations of current signal passing through the sensor unit, based on turn-on extent of the second switching element, hereby obtaining at least a touch message.
ORGANIC LIGHT EMITTING DIODE DISPLAY DEVICE INCLUDING TOUCH PANEL	12.06.2014; US20140160047	LG Display Co., Ltd	CHOI Bong-Ki	Disclosed is an organic light emitting diode (OLED) display device which includes an OLED array formed on a lower substrate; a touch panel attached to the lower substrate and including first and second sensor electrodes for sensing a touch and a routing line electrically connected to at least one of the first and second sensor electrodes and exposed to an upper surface of the touch panel; and a connection line electrically connecting the OLED array and the touch panel through an exposed portion of the routing line.
FLEXIBLE TOUCH SCREEN PANEL	30.01.2014; US20140028584	SAMSUNG DISPLAY CO., LTD.	Park Jung-Mok	A flexible touch screen panel in which metal wire sensing patterns are formed as a touch sensor on a first surface of a flexible thin film is provided. The flexible touch screen panel includes a thin film divided into an active area and a non-active area adjacent to the active area, sensing patterns in

				the active area on a first surface of the thin film, and sensing lines in the non-active area on the first surface of the thin film and connected to the sensing patterns. The sensing patterns include nanowire.
METAL NANOSTRUCTURED NETWORKS AND TRANSPARENT CONDUCTIVE MATERIAL	27.12.2013; WO/2013/192437	C3NANO INC	VIRKAR, Ajay	Metal nanowires, such as silver nanowires coated on a substrate were fused together to form fused metal nanowire networks that have greatly improved conductivity while maintaining good transparency. Materials formed from the fused metal nanowire networks described herein can have a transparency to visible light of at least about 85% and a sheet resistance of no more than about 100 Olims/square or a transparency to visible light of at least about 90% and a sheet resistance of no more than about 250 Olims/square. In addition to maintaining good transparency, the materials formed from the sintered metal nanowire networks can have a haze of no more than 0.5. The method of forming such a fused metal nanowire networks are disclosed that involves exposure of metal nanowires to various fusing agents on a short timescale. The resulting sintered network can have a core-shell structure in which metal halide forms the shell. Additionally, effective methods are described for forming patterned structure with areas of sintered metal nanowire network with high conductivity and areas of un-sintered metal nanowires with low conductivity. The corresponding patterned films are also described. When formed into a film, materials comprising the metal nanowire network demonstrate low sheet resistance while maintaining desirably high levels of optical transparency with low haze, making them suitable for transparent electrode, touch sensors, and other electronic/optical device formation.

Exhibit 1 lists some of the recent published patents on touch sensors.

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