TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

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1. ULTRASONIC BIOMETRIC SENSOR

In 2012, total false trades using cards reached €1.33 billion (about $1.6 billion at the current exchange rate) according to the European Central Bank. To detect identity frauds, biometric recognition systems are being deployed in airports, but these systems can be easily hacked by using fake fingerprints. Because of the increase in the number of fraudulent transactions and identity thefts, it is vital for various organizations to deploy accurate, reliable, and authentic devices, which can detect fraudulent transactions without errors.

To address the above challenges, a Florida-based company, Sonavation, has developed a three-dimensional (3D) surface imaging technology for biometric authentication. According to sources at Sonavation, the device has gone through many fraud tests and enables more secure identification and prevents hacking.

The 3D surface imaging technology employs the thinnest ultrasonic biometric sensor. The ultrasonic biometric sensor is composed of thin, diced piezo ceramic tiles. The ceramic material is employed to build a robust and water resistant device which can be responsive in both outdoor and indoor environments. The tile is 100 micrometers thin and is further cut into rows and columns to form pillars. The pillars are fabricated with the epoxy resin which is further connected with an application-specific integrated circuit (ASIC). The pillars are powered with an external source which causes them to vibrate and generates sound waves of 15 MHz. These sound waves further help to detect the fingerprint. The device utilizes high-frequency acoustic energy or sound waves to penetrate the epidermal layers of the skin that maps the acoustic impedance of the tissue. The device is able to penetrate 8 millimeters deep inside the finger, allowing it to gather information about the finger and the layers of the skin, such as dermis, epidermis, root of nail, nail matrix, nail bed, distal phalanx, underlying flat bed, and the entire blood flow and bone structure. Thus, this process results in accurate authentication.

The 3D surface imaging technology by Sonavation can be deployed to easily upgrade existing security solutions. In large organizations, the device can be used to grant or restrict the access of employees in highly secure areas. Biometric

information is stored in the device which makes it a secure system. The device is very fast and authenticates the user in approximately less than a second.

The project was self-funded by Sonavation. The company's biometric sensor solution is ready for commercialization. Sonavation has also come up with an additional line of sensors in biometrics comprising thin swipe and touch sensors. There is excitement among consumers for biometric scanning in smart phones. Key companies, such as Apple Inc. (USA) and Samsung Electronics Co. (Korea) have utilized this feature in their latest high-end smart phones. Biometric scanning is expected to penetrate low- end phones because of the wider adoption.

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2. CANTILEVER-BASED MOTION DETECTOR

There is a continuous quest by various government agencies to figure out the presence of life on Mars. Previously, chemical detection was the primary source to help detect the presence of life on other planets. This type of detection has proven to be irrelevant in detecting living organisms. There is a need for a device which is easy to use and accurate enough to track living bacterium. In addition, the device should be reliable enough to track living bacteria from various sources such as soil, water, and yeast among others.

To address the above challenge, researchers from Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland have developed a motion detector with a nano-sized cantilever. The researchers at EPFL have developed this motion detector to identify microorganisms or the motion of the bacteria or existence of life without the need for previous chemical knowledge. The device is very easy to use and provides information with high accuracy.

The nano-sized cantilever is employed to detect motion**.** A beam is anchored at one end, and the other end bearing a load is called a cantilever. Basically, the cantilever was often used for buildings and bridges. To track the motion of bacteria, a cantilever is implemented on the micrometer scale. Approximately 500 bacteria can be deposited on the cantilever. If the bacteria are attached to the cantilever, sensitive and smaller cantilevers will start moving with respect to the bacteria, and bacteria will move only if they are alive. This movement in the cantilever results in the motion. This motion as the series of vibrations is further captured with the help of a read out laser. The motion in the cantilever accounts

for the presence of life. Researchers at EPFL have successfully tested the device with yeast, bacteria, an animal, that is, mouse, and human cells. A test was also conducted by attaching soil from fields and water from the river. The device was able to detect accurately the presence of living cells.

The device will be utilized by pharmaceutical companies for drug development. It can be covered with cancer cells or bacteria and protected with the help of drug compounds. If the drugs are operational on the bacteria and the cancer cell, the motion of the device will decrease or it might stop completely as soon all the bacteria or cancer cells die. This device is very fast compared to conventional throughput systems employed by pharmaceutical companies while identifying antibiotics for bacteria.

The project was supported by the Vlaams Institute for Biotechnology and the University of Lausanne. The researchers are currently working on identifying various applications that can be enabled by the device. Once the device is successfully commercialized, it has opportunities to get a good response from pharmaceutical companies to identify antibiotics. The researchers are currently approaching ESA (European Space Agency) and NASA (National Aeronautics and Space Administration) to promote the use of their device in the search for life on other planets.

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3. TACTILE AND TORQUE SENSING FOR INDUSTRIAL ROBOTS

In the aviation industry, people have to squeeze through small enclosed areas, lift heavy objects, and carry out repetitive tasks which can lead to back injuries and repetitive strain. Stationery robots are used in the car manufacturing industry, but the construction of aircraft is different and poses a challenge to robotics. There is need to bring industrial robots on the factory floor of the aviation industry to carry out tedious and uncomfortable tasks. To boost the productivity and efficiency of the factory, there is a need for autonomous robots that are easy and safe to use.

To address the above challenge, Validation of Advanced, Collaborative Robotics for Industrial Applications (VALERI) a consortium supported by the European Commission has developed a mobile robot capable of autonomous operation.

The VALERI industrial robot provides laser scanners, tactile sensing and torque sensing primarily for safety and functionality. The sensors are employed for contact detection, collision detection, and interaction. In addition to sensors, the robot also has a two and half dimensional workspace monitoring system. This system includes three (near infrared/visible light) gray scale cameras for enhanced vision and one camera with illumination in the center. The three-dimensional data from both camera systems are fused together to get the final results. The results are further processed to determine whether the safety zone is penetrated and any human or unknown object is too close for collision. The operator can easily move the robot in a vertical or rotational direction. The VALERI robot has 2 additional degrees of freedom: first, it can lift the robot (linear axis), and in addition it can turn the column (rotational axis). For higher precision without moving the platform and to increase the workspace, the rotational axis was introduced.

The VALERI robot has 12 degrees of freedom (DOF) overall-7 DOF from-the arm of the robot,3 DOF from the omnidirectional platform, and 2 DOF from the column, which can rotate around 270 degrees and lift the robot up to 970 mm. The robot can reach a diameter of approximately 2600 mm with the help of the rotational axis. With additional linear axis, there has been an increase in the workspace. The flange can now reach up to 2700 mm and can reach the floor. Upon successful completion of the project, the robot is expected to be deployed on the production floors of Airbus and Austrian FACC. The introduction of the industrial robot will help eliminate back problems and repetitive strain injuries for employees while lifting heavy objects and the cost of production can be kept competitive.

The project Validation of Advanced, Collaborative Robotics for Industrial Applications was funded by the European Commission under the 7th Framework Programme ('Factories of the Future' Public-Private Partnership). The project started on November 2012 with initial duration of 36 months and coordination from Fraunhofer IFF. The collaborating partners are Fraunhofer Institute for Factory Operation and Automation IFF, Germany; KUKA Laboratories GmbH, Germany; Airbus Defense and Space, Spain; IDPSA Engineering and Robotics, Spain; PROFACTOR GmbH, Austria; PRODINTEC, Spain; FACC AG, Austria. By mid-2015, the consortium is planning to test the mobile robot and develop some applications which can be further integrated into the aerospace industry.

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4. RECENT PATENTS IN THE FIELD OF PRESSURE SENSORS

Pressure sensors are typically employed to measure the pressure of a liquid or gas. Pressure sensors can also indirectly measure various parameters, such as gas or liquid flow, water level, altitude. The most common type of electronic pressure sensor are those that measure strain or deflection due to applied force or pressure. Pressure sensing technologies based on this method in include piezoresistive (including silicon micromachined strain gauge sensors), piezoelectric sensors, capacitive sensors, potentiometric sensors, optical sensors, electromagnetic sensors. Furthermore, resonant frequency sensors use a change in the resonant frequency to determine stress or change in gas density, due to applied pressure. To provide enhanced efficiency, better performance, and more accurate results, pressure sensors are utilizing digital technology.

Growth applications for pressure sensors include consumer electronics (such as indoor navigation in mobile phones), automotive (where silicon micromachined pressure sensors are used in applications such as manifold absolute pressure sensors, tire pressure monitoring systems, barometric pressure; as well as applications such as in-cylinder pressure sensing), industrial (such as heating, ventilation, air conditioning, oil and gas), medical (such as blood pressure monitoring, sleep apnea monitoring, ventilators, dialysis machines). There are also increasing opportunities for wearable, very low power pressure sensors for applications such as blood pressure monitoring. Advancement in technologies, such as NEMS (nanoelectromechanical systems) and MEMS (microelectromechanical systems) are contributing globally towards the growth of pressure sensors.

Some of the participants investing in R&D of pressure sensing include Emerson Process Management, Freescale Semiconductor Ltd., Schneider Electric SE, ABB Ltd, STMicroelectronics N.V, Delphi Automotive PLC, Honeywell International Inc., Omron Corporation, Robert Bosch Gmbh, Analog Devices Inc., and so on.

A recent patent in pressure sensing is a Magnetic Force Transmission Type Tire Pressure Sensor Device And Related Setting Tool And Setting Method, (US20140368325) is assigned to Cub Elecparts Inc., which includes a magnetic fore transmission tire pressure sensor and transmitter with the ability to provide wireless transmission.

Around 564,931 patents have been registered under pressure sensing in recent times. Of these, approximately 130 patents were registered in Africa, which includes Egypt, Kenya, Morocco, and South Africa; approximately 25,851 patents were registered by America, which includes USA and Canada; approximately

10,979 were registered by the European Patent office; approximately 15,773 patents were registered by China; approximately 22,571 patents were registered by Japan; approximately 11,081 were registered by Republic of Korea; approximately 75 patents were registered by Israel; and many more were registered under pressure sensing in different parts of the world.

Title	Publication Date/ Publication Number	Assignee	Inventor	Abstract
MAGNETIC FORCE TRANSMISSION TYPE TIRE PRESSURE SENSOR DEVICE AND RELATED SETTING TOOL AND SETTING METHOD	18.12.2014; US20140368325	CUB ELECPARTS INC.	YU San-Chuan	A magnetic force transmission type tire pressure sensor device and related setting tool and setting method is disclosed. The invention uses a magnetic force sensor unit in the tire pressure sensor device, to receive lines of magnetic flux being transmitted by a magnetic force transmitter unit in the setting tool, and then the received waveform is converted into a communication protocol and stored in the tire pressure sensor device. Therefore, the invention not only can achieve the purpose of wireless transmission but also can enhance the stability of signal transmission, eliminate wireless regulatory constraints and improve product quality.
Pump Housing for a Motor Vehicle Hydraulic Assembly with a Connection for a Wheel Pressure Sensor or a Master Brake Cylinder Pressure Sensor	18.12.2014; US20140366524	Robert Bosch GmbH	Schlitzkus Michael	A pump housing has at least two inlet valve openings located in a first row, at least two outlet valve openings located in a subsequent second row, and at least one high-pressure switching valve opening and at least one changeover valve opening located in a further subsequent fourth row. At least one connection for a wheel pressure sensor is positioned in a third row between the second and fourth rows. At least one connection for a master cylinder pressure sensor is positioned in a fifth row following the fourth row.
PRESSURE SENSOR, ACOUSTIC MICROPHONE, BLOOD PRESSURE SENSOR, AND TOUCH PANEL	18.12.2014; US20140369530	Kabushiki Kaisha Toshiba	FUJI Yoshihiko	According to one embodiment, a pressure sensor includes a film part, and a sensing unit. A circumscribing rectangle circumscribing a configuration of a film surface of the film part has a first side, a second side, a third side connected to one end of the first side and one end of the second side, a fourth side connected to one other end of the first side and one other end of the second side, and a centroid of the circumscribing rectangle. The circumscribing rectangle includes a first region enclosed by the first side, line segments connecting the centroid to the one end of the first side, and to the one other end of the first side. The sensing unit includes sensing elements provided on a portion of the film surface overlapping the first region. Each sensing element includes a first, second magnetic layers, and a spacer layer.

WIRELESS INTERSTITIAL FLUID PRESSURE SENSOR	04.12.2014; US20140371624	Purdue Research Foundation	Ziaie Babak	An implantable pressure sensor arrangement is disclosed. The arrangement includes a substrate, a coil positioned on the substrate, a flexible membrane positioned proximate to the coil and configured to be moveable with respect to the coil, thereby forming a fluid chamber, fluidly sealed from outside of the implantable pressure sensor arrangement, a porous membrane positioned on the flexible membrane and configured to transfer pressure from outside of the implantable pressure sensor arrangement onto the flexible membrane wherein a differential pressure is generated on the two sides of the flexible membrane thereby causing the flexible membrane to deflect towards and away from the coil, and an electrode coupled to the flexible membrane.
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.
SENSOR WITH ELECTRICAL CONTACT PROTECTION FOR USE IN FLUID COLLECTION CANISTER AND NEGATIVE PRESSURE WOUND THERAPY SYSTEMS INCLUDING SAME	18.12.2014; US20140371697	SMITH & NEPHEW, INC	Braga Richard M.	A sensor for use in a canister for fluid collection, the canister having a canister top and defining a fluid collection chamber. The sensor includes a first electrode and a second electrode. The first electrode includes a first portion and a second portion, wherein the first portion of the first electrode is supported by the canister top, and the second portion of the first electrode is configured to extend into the fluid collection chamber. The second electrode includes a first portion and a second portion, wherein the first portion of the second electrode is supported by the canister top, and the second portion of the second electrode is configured to extend into the fluid collection chamber. The sensor also includes an electric circuit configured to detect an electrical property associated with the first and second electrodes.

PRESSURE MEASURING DEVICE FOR A COMBUSTION CHAMBER PRESSURE SENSOR	17.12.2014; EP2812664	BOSCH GMBH ROBERT	EBERHARDT RENE	The invention relates to a pressure measuring device for a combustion chamber pressure sensor for an internal combustion engine. The pressure measuring device comprises a retaining part (12) which has a support surface (16) for a signal processing unit, a glow plug busbar (32), sensor element busbar parts (28), and sensor element busbars (34, 36). The connector interface part (14) contains sensor contacts (60, 62, 64) and a glow plug current contact (66). At least the sensor contacts (60, 62, 64) are encapsulated by the material (80) of the connector interface part (14).

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

Picture Credit: Frost & Sullivan

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