TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

23 January 2015

1. OPTICAL FIBER PYROMETER TO MEASURE CHANGES IN TEMPERATURE

In industrial environments, it is important to monitor changes in temperature. Conventional techniques which are being used to measure temperature may not have access to all the areas in the industrial environment. There is a need for clear vision to monitor tool cutting points, where thermographic infrared cameras or thermocouples may have difficulty in an industrial environment. There is a need for a new device or a technique which can be used to monitor changes in temperature in places where infrared cameras and thermocouples may not be useful. The device or technique should be easy to use and cost effective.

To address the above challenge, researchers from Charles III University of Madrid, Spain, have developed a way to measure the temperature of any machine or cutting process inside industrial environments by using an optical fiber pyrometer.

The optical fiber pyrometer is made up of silicon dioxide and can withstand very high temperature. The optical fiber pyrometer can start measuring temperature from 300 degrees C up to 1000 degrees C**.** A pyrometer measures in non-contact fashion the thermal footprint of any object. When the temperature of the object increases, the emitted energy also increases simultaneously. The researchers measured the emitted energy in two different colors, and with the help of this data, they were able to determine the temperature with the help of quotients of the two signals. This change in temperature is very useful in the industrial environment to figure out whether the machine tool is functioning properly and the material is able to maintain its properties once it has been mechanized.

Once the project is successfully completed, the technology will be used in the aerospace sector to avoid extreme changes in temperature. In the aerospace industry, it is important to develop lightweight engines and materials such as Inconel. It is also vital that, once the machining process is over, the material maintains its properties to ensure that problems do not occur during flight. The changes in temperature are expected to have serious effects on the components of motors, which can further negatively impact performance. It is expected that optical fibers for measuring temperature can also be used in the biomedical field. According to the researchers, monitoring changes in temperature during manufacturing can help optimize the life of a tool which will further lead to improved productivity. The system can be applied in any environment using machine tools to manufacture certain parts and ensures productivity in the assembly process.

The research was funded by the Ministry of Economics and Competitiveness as a part of the National Plan project. In addition, the research was funded by Autonomous Community of Madrid as a part of the SINFOTON research program. The research was supported by various departments of Charles III University of Madrid. The researchers are currently working on identifying different application sectors where optical fiber can be deployed to measure temperature.. Once the project is successfully commercialized, it has opportunities to get a good response from the aerospace sector where mechanical tools are used to manufacture different parts.

Details: Carmen Vázquez, Professor, Charles III University of Madrid, Av de la Universidad, 30, 28911, Madrid, Spain. Phone: +34916249191. E-mail: cvazquez@ing.uc3m.es, mcarmen.vazquez@uc3m.es. URL: http://www.uc3m.es/.

2. GRAPHENE-BASED MULTIMODAL BIOSENSOR

It is very important to detect the presence of different types of proteins in the body. Conventional biosensors that are used in biomedical applications tend to be used to detect only one type of protein. To detect specific types of proteins, bio sensors need to be custom made. There is a need to develop advanced biosensors that will be able to detect all types of proteins in the blood biomarkers. In addition, the device should also be deployed to diagnose illnesses in advance. It should be easy to use as well as accurate and differentiate the charge and mass of different proteins.

To address the above challenge, researchers from the University of Pennsylvania have developed a graphene-based biosensor which can work in three different modes--mechanical, electrical and optical.

Graphene is used in the construction of the sensor because of its unique electrical properties. Graphene allows electrical, optical and mechanical modes to operate simultaneously without any interference from each other. In addition, graphene is very thin in nature. The base of the sensor is made of silicon nitride, which is further coated with a layer of graphene and thick lattice of single carbon atoms. A coating of a carbon atom on the graphene helps to attract protein without deploying any additional functionality. In this manner, the graphene-based biosensor detects proteins. In the electrical mode, protein binds to the graphene, resulting in change in the number of carriers and conductance properties. In the mechanical mode, when protein binds to the graphene; there is a change in the total mass which further changes the resonance of the graphene with respect to the total mass. In optical mode, reflection is measured. When visible light is directed towards the sensors and protein binds to the sensor, there is a change in the refractive index.

Once the project is successfully completed, the technology can be used in biomedical applications for early diagnosis of certain cancers using blood biomarkers. In different patients the concentration of blood varies in orders of magnitude. This sensor will be used to make multiple detections in the blood biomarkers and identify a range of proteins through their mass. This sensor can be used as an all-purpose biosensor to detect different types of proteins. It can also be used to detect all the proteins in blood biomarkers and also distinguish between charge and mass.

The project was funded under the grant IIP-1312202 and ECCS-1408139 by the National Science Foundation; and supported by the material science and electrical engineering department of University of Pennsylvania. The researchers are currently working on investigating the feasibility of multimodal sensors to identify proteins from unknown samples.

Details: Ertugrul Cubukcu, Assistant Professor, Material Science and Engineering, University of Pennsylvania, Philadelphia, PA 19104, United States. Phone: 215-898-7975. Email: cubukcu@seas.upenn.edu. URL: http://www.upenn.edu/

3. PRINTED SENSOR FOR MONITORING GLUCOSE LEVELS

Wearable devices are gaining momentum across various sectors, such as healthcare, consumer electronics and many others. Printed sensors find application in wearable electronics, especially in the healthcare market. There are devices available in the market to monitor patients' glucose levels, pulse levels, heart beats, and many more. In glucose sensing, it is advantageous to have sensors that are comfortable to use and non-invasive.

The devices available in the market to monitor glucose levels can cause irritation to the skin when worn for longer periods of time. This further leads to the discontinuation of use of the device in the body. In addition, these devices may not be able to track the glucose levels of a diabetic patient in real time. There is a need for a device that is compatible with the human body and does not cause any irritation while performing different tasks. The device should be easy to deploy and easy to remove; it should also be cost effective and provide accurate results.

To address the above challenge, researchers from the University of California, San Diego, have developed a printed flexible sensor to measure glucose levels. The researchers are calling the printed sensor a temporary tattoo, which can be carried anywhere along with the body.

Researchers at the University of California, San Diego, have deployed the sensor on a flexible paper substrate (tattoo paper). The printing technique is used to print the patterned electrode on the flexible paper substrate. For ten minutes, a mild electric current is applied to the skin. This mild current allows the sodium ions between the skin cells to move towards the electrode and generate the electrical charge. The sodium ions also consist of the glucose molecules and the overall electric charge produced by the glucose is used to monitor the overall glucose level in the person’s body.

Once the project is successfully completed, the technology will be used to measure glucose levels in the fluid between skin cells. The device can also be used to measure other chemicals, such as metabolite which is helpful in analyzing athletes’ fitness and other chemicals, which the device would be able to locate and monitor. In the future, the printed sensor can also be used to monitor the effects of medication on the patient’s body. It might also be used to monitor illegal drugs, alcohol and certain protein products.

The project was self-funded by the University of California, San Diego; and supported by the Center for Wearable Sensors, San Diego. The researchers are currently working on developing a numerical readout for the patient glucose levels. In addition the researchers are also working on identifying different applications for the device. Once the project is successfully completed, it has the potential to get a good response from the biomedical industry. It has been tested on seven people and the final results were accurate and the wearer was able to use the device without any irritation.

Details: WenzhaoJia, Researcher, Nanoengineering, University of California, San Diego, 9500 Gilman Dr., La Jolla, CA 92093. Phone: 858- 534-2230. E-mail: wejia@ucsd.edu. URL: https://act.ucsd.edu

4. RECENT PATENTS IN THE FIELD OF PROXIMITY SENSORS

Proximity sensors are able to sense the presence of specific, approaching objects or targets without having any physical contact with those objects/targets.

Because of the lack of physical contact between objects and sensors and the absence of mechanical parts, proximity sensors have long functional life and high reliability.

The different types of proximity sensors available in the market include capacitive proximity sensors, inductive proximity sensors, ultrasonic proximity sensors, magnetic proximity sensors, infrared/optical proximity sensors, and photoelectric proximity sensors.

The growth areas for proximity sensors include the consumer electronics sector (touch screens and smart phones) and the automotive sector (driver assistance systems/park assist, and autonomous cars). In addition, proximity sensing is employed in applications, such as detecting, inspecting, and positioning in manufacturing systems and automated machines, plastic modeling; packaging; food processing; metal working; conveyor systems; touch screens; and many more. There has been significant advancement in the capacitive proximity sensing technology market.

Some of the participants investing in R&D for proximity sensing are Panasonic Intellectual Property Management Co., Ltd., Synaptics Incorporated., Motorola Mobility LLC, Mitsubishi Electric Corp, Honeywell INT INC, Hyundai Motor Company, Nvidia Corporation, Jaguar and Land Rover Limited, among others.

A recent patent in proximity sensing powered by a microwave oscillator (WO/2015/000452) is assigned to BALLUFF GmbH and pertains to a proximity sensor and method for measuring the distance from an object. This proximity sensor contains a microwave oscillator that provides an output signal that is reflected by an object and received by the proximity sensor.

In recent times, approximately 11995 patents have been globally registered under proximity sensing. These registered patents include 26 patents in Africa (which includes Egypt, Kenya, Morocco, and South Africa), 5532 in America (which includes USA and Canada), 1763 in the European Patent office, 1105 in China, 1752 in Japan, 1506 in the Republic of Korea, 15 in Israel, and many more in rest of the world. In 2015, approximately 6 patents have been registered under proximity sensing.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
PROXIMITY SENSOR AND METHOD FOR MEASURING THE DISTANCE FROM AN OBJECT	08.01.2015; WO/2015/000452	BALLUFF GMBH	FERICEAN, Sorin	The invention relates to a proximity sensor (10) and to a method for measuring the distance (D) from an object (12). The proximity sensor (10) contains a microwave oscillator (52) which provides, as an output signal (54), a transmission wave (16) which is emitted by the proximity sensor (10) in the direction of the object (12) as a free space transmission wave (16c) which is reflected by the object (12), which is electrically conductive or has at least one electrically conductive surface, as a free space reflection wave (30a) and is received by the proximity sensor (10) as a reflection wave (30), wherein the reflection coefficient (Γ) is determined from the transmission wave (16) and the reflection wave (30) and is provided by the proximity sensor (10) as a measure of the distance (D). The proximity sensor (10) according to the invention and the method according to the invention are distinguished by the fact that the transmission wave (16) is guided in a waveguide (22) as a waveguide transmission wave (16b), that the transmission wave (16) is injected into the waveguide (22) with a wave mode which results in the waveguide transmission wave (16b) being separated at the aperture (26) at the front end of the waveguide (22) into the free space transmission wave (16c) and in the free space transmission wave (16c) propagating to the object (12).
ANTENNA ELEMENT AS CAPACITIVE PROXIMITY/TOUCH SENSOR FOR ADAPTIVE ANTENNA PERFORMANCE IMPROVEMENT	18.12.2014; US20140366524	MOTOROLA MOBILITY LLC	ABDUL-GAFFOOR MOHAMMED R	A method and communications device for providing antenna tuning to compensate for antenna de-tuning caused by a presence of an object detected using an antenna element within a capacitive touch and proximity sensor (CTPS). The CTPS propagates object detection signals associated with a detected object to a detection IC. An object detection and antenna tuning (ODAT) logic uses object detection signal information to generate tuning control signals to trigger compensatory antenna tuning, based on pre-established mappings of object detection signal data and antenna tuning states. The tuning control signals indicate at least one of (a) a level of compensatory antenna impedance tuning and (b) an amount of compensatory antenna length adjustment. In response to generating the tuning control signals, the ODAT logic triggers the propagation of the tuning control signals to the antenna matching and control circuit to provide the corresponding antenna tuning.

OPTICAL PROXIMITY SENSORS	11.12.2014; US20140364218	Neonode Inc.	Holmgren Stefan	A proximity sensor including a housing, a plurality of light pulse emitters for projecting light out of the housing along a detection plane, a plurality of primary light detectors for detecting reflections of the light projected by the emitters, by a reflective object in the detection plane, a plurality of primary lenses oriented relative to the emitters and primary detectors in such a manner that for each emitter-detector pair, light emitted by the emitter of that pair passes through one of the primary lenses and is reflected by the object back through one of the primary lenses to the detector of that pair when the object is located at a position, from among a primary set of positions in the detection plane, that position being associated with that emitter-detector pair, and a processor for co-activating emitter-detector pairs, and configured to calculate a location of the object in the detection plane.
METHOD, APPARATUS, AND COMPUTER PROGRAM PRODUCT FOR COMBINED TAG AND SENSOR BASED PERFORMANCE MODELING USING REAL-TIME DATA FOR PROXIMITY AND MOVEMENT OF OBJECTS	11.12.2014; US20140364975	ZIH Corp.	Wohl Michael A.	Systems, methods, apparatuses, and computer readable media are disclosed for providing performance modeling by combining tags and sensors providing real time data on movement and proximity of tagged objects. In one embodiment, a method is provided for monitoring a participant that at least includes correlating at least one tag to the participant; receiving blink data transmitted by the at least one tag; determining tag location data based on the blink data; correlating a sensor to the participant; and receiving sensor derived data. The method further includes receiving participant role data; comparing the tag location data to participant dynamics/kinetics models based at least in part on the participant role data; and determining the participant location data based on comparing the tag location data and the sensor derived data to the participant dynamics/kinetics models.
USE OF PROXIMITY SENSORS FOR INTERACTING WITH MOBILE DEVICES	04.12.2014; US20140357251	QUALCOMM Incorporated	Forutanpour Babak	Various arrangements for handling a call by a mobile device and/or selecting a function for execution by the mobile device are presented. A phone call may be commenced by a mobile device. During the phone call, the mobile device may collect proximity data that indicates the mobile device is not proximate to an ear of a user. The microphone of the mobile device may be muted in response to the proximity data that indicates the mobile device is not proximate to the ear of the user.

PROXIMITY SENSOR AND AUTOMATIC FAUCET	04.12.2014; WO/2014/192230	LIXIL CORPORATION	SHIRAI, Yuki	A proximity sensor (1) provided with a measurement distance determination unit (321) for determining whether the distance to a detection object is within a prescribed detection distance range, a light reception amount determination unit (322) for determining whether an amount of received light is greater than or equal to a light reception amount threshold, and a continuation determination unit (323) for determining whether a state in which a detection object is present is continuing, said light reception amount determination unit (322) being such that after it is determined that there is a detection state and water discharge starts, during the period in which the continuation determination unit (323) determines that the state in which the detection object is present is continuing, the light reception amount threshold is set to a lower value than the value before water discharge started.
CAPACITIVE PROXIMITY SENSOR	26.11.2014; EP2805222	OECHSLER AG	WEISSKOPF MATTHIAS	The invention relates to a high-resolution capacitive proximity sensor (11) with high-quality haptics and optics, said proximity sensor having a ceramic disk, behind which electrode sectors (18) are located. The ceramic disk is the base (13) of a flat pot (12) which is produced integrally in a ceramic injection molding process. Defined surface structures of the operating surface (14) on the pot base (13) are used in particular for tactile user guidance, while illuminated regions of the pot base (13) are used for optical user guidance, the pot base being axially accessible from the outside. The sensor circuit (16), which is placed in the pot (12) behind the electrode sectors (18), facing away from the operating surface, is surrounded by an electric conductor (27) in order to dissipate electrostatic charges, said conductor preferably being designed as an elastic buffer against the radial assembly environment.

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

Picture Credit: Frost & Sullivan

Back to TOC

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You can call us at: **North America**: +1-843.795.8059, **London**: +44 207 343 8352, **Chennai**: +91-44-42005820, **Singapore**: +65.6890.0275