TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

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1. ADVANCEMENTS IN POWER LINE MONITORING SENSORS

Increasingly, the electric power sector is interested in large-scale (eventually pervasive) sensing solutions to optimize the operation of the smart power grid.

Continuous monitoring of electric power lines provides key benefits, such as the ability to accurately determine and forecast the line's dynamic line rating (DLR) based on real-time changes in environmental conditions (e.g., wind, sun, temperature) that can affect the line's current carrying capacity; improved safety, reliability, and grid utilization; improved determination and handling of power outages; prevention of overloading the line; ability to add capacity where it is most needed, to reduce line congestion, and to dispatch energy more efficiently.

Historically, electric power utilities have a static line rating method--a fixed rating based on conservative, worst-case climate conditions. Real-time monitoring of utility high-value transmission lines can enable shifting loads to other lines when a particular line is undergoing maintenance or to divert power to meet expanding or changing user demands.

A real-time DLR can be achieved by monitoring key parameters, such as, wind speed, conductor and ambient temperature, line sag, and line current. It can also be beneficial to monitor line motion to determine line galloping (oscillation of a line exposed to wind, ice or snow) or aeolian vibration (vortices generated by an air stream).

Transmission lines that are of high value, carry much power, and are more expensive to replace are especially logical and promising applications for power line monitoring systems.

Furthermore, opportunities exist to monitor parameters such as current and voltage as well as conductor temperature on distribution lines, for improved identification and rectification of faults or outages. Information about other key parameters, such as, line sag or movement, could also benefit monitoring of distribution lines.

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2. MAGNETIC FIELD SENSORS FOR PERIMETER FENCES

Certain highly restricted areas are secured with the help of fencing, cameras, sensors, and human guards. Cameras and sensors used in these facilities can have difficulty withstanding changes in environmental conditions. A fence can be easily climbed or cut with the help of bolt cutters. Costs associated with human guarding are very high. There is a need for a new device or system, which can detect trespassers, or drones crossing the fence without making any contact. The device should be cost-effective, highly sensitive, and accurate enough to detect and identify the change in the condition over miles of perimeter.

To address the above challenge, researchers from the University Saarland have developed magnetometers--very sensitive magnetic field sensors for surveillance that can detect disturbances that influence the Earth's magnetic field.

The researchers are planning to integrate the sensors and linearly arrange the sensors inside the cable. The diameter of the cable will be approximately equivalent to the diameter of the electrical cable. The sensors in the cable are networked and able to monitor the disturbances over miles of the perimeter fencing. The sensors are contactless, consume very low power, and are not subject to wear. The sensors are unaffected by rain and fog and independent of weather conditions. The change in the surroundings is registered by the sensor and transmitted to the analyzer unit. The magnetic sensors are highly sensitive to change in condition and specify the location of disturbance with high precision. The cable can be either attached to the fence or can be buried inside the ground.

The sensors will also be used to detect vibrational disturbances in the surroundings of the magnetic field. They will be able to detect the drones flying over the fence. In addition the sensor will be used to detect any tampering with the fence. It will detect the trespassers and even the slight motion of the metal fence when it swings back and forth. The magnetic field sensors will detect all kinds of disturbances in the surrounding magnetic field. The researchers are currently working on refining the technology so that it will be able to detect and identify the type of vibration or disturbance.

The project was funded by the Federal Ministry of Education and Research. In total, over €1 million (about US $1.08 million at the current exchange rate) was provided by the Ministry, of which €250,000 (about US$270,000 at the current exchange rate) was allocated to the Saarland University (Germany). The project was supported by the industrial partners Sensitec GmbH and GBA-Panek GmbH. Researchers are working on recognizing the cause of disturbances and identifying the false alarm triggered by animals or winds. They are working with the industrial partners to mass produce a cable, which will be linearly arranged with the sensors. The researchers are identifying ways to reduce the cost of the sensors, which will be further helpful for large volume production. Once the project is successfully commercialized, it has opportunities get a good response from the airports authorities, nuclear power stations, private properties, and industrial sites.

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3. ADVANCEMENTS IN MOBILE MONITORING OF PARKINSON'S DISEASE

Parkinson's disease is a progressive disorder of the human nervous system that affects an individual's movement. Symptoms include tremors, slowed movement (bradykinesia), rigid muscles, impaired posture or balance, loss of automatic movements. Moreover, difficulty performing voluntary movements (dyskinesia) can be a side effect of long-term use of the drug levodopa to treat Parkinson's disease.

The motion sensors, such as accelerometers or gyros, that are used in wearable or mobile devices for applications such as monitoring exercise may not provide an accurate direct measure of Parkinson's symptoms, such as tremors or slowed movement, as these symptoms have distinctive features. To measure Parkinson's, it is vital to position the sensors appropriately and to extract the key data.

US-based Great Lakes NeuroTechnologies (GLNT), which was spun-off from Cleveland medical Devices Inc., in 2011, has launched its Kinesia 360 solution for continuous, mobile assessment of Parkinson's disease. The system uses wireless, patient-worn sensors and a smart phone app to monitor Parkinson's symptoms (tremor, dyskinesia, mobility) throughout the day. One sensor band is worn the wrist, another sensor band is worn on the ankle. The sensor bands communicate via Bluetooth. Data and reports are remotely transmitted to a secure web portal for access by clinicians and researchers. Kinesia 360TM embodies enhanced protocol design, positioning and sensitivity of the sensors, and intelligent algorithms for processing data.

The Kinesia 360 device provides highly convenient yet sensitive monitoring of Parkinson's symptoms, with strategically located sensors, that minimally impact the patient's time or daily activities.

GLNT determined that two sensors are beneficial for accurately accessing symptoms. GLNT sources noted that the sensors in mobile devices such as a mobile phone or watch are suitable for general activity but not for assessing Parkinson's symptoms. Using two sensors allows for filtering out motions that are not related to Parkinson's symptoms.

Kinesia technology obtained clearance from the US Food and Drug Administration (FDA) on April 6, 2007 through the 510(k) approval process. That Kinesia device was indicated to monitoring physical motion and muscle activity to quantify the kinematics of movement disorder symptoms, such as tremors; and assess activity in all instances where quantifiable analysis of motion and muscle activity is desired. This device consisted of a wrist module and ring sensor. Motion sensors, including accelerometers and gyroscopes, are integrated into a finger-worn unit to capture three dimensional motions. The finger-worn sensor unit is connected to a wrist-worn module by a thin wire. The wrist module provides input for such capabilities as an embedded radio for real-time wireless transmission of the signals.

The Kinesia Homeview patient kit includes a patient-worn motion sensorthat measures linear acceleration (accelerometers) and angular velocities (gyroscopes) while the patient completes an automated motor assessment. Data is transmitted from the wireless sensor to the tablet using a Bluetooth radio. Objective features are then extracted from the motion sensor data which correlate to Parkinson's motor symptoms of tremor, bradykinesia, and dyskinesia.

This development has been supported by the National Institute of Health through the SBIR (Small Business innovation Research) program, specifically the National Institute of Neurological Disorders and Stroke and the National Institute on Aging (R44AG033947, 2R44NS065554, & R44AG044293).

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4. RECENT PATENTS IN THE FIELD OF 3D IMAGE SENSING

Conventional CMOS (complimentary metal oxide semiconductor) and CCD (charge coupled device) image sensors capture a two-dimensional (2D) representation of a scene. Three-dimensional (3D) image sensors are able to capture depth and distance information to provide a 3D image. CMOS 3D image sensing technology has received considerable attention in recent times because of its spirited growth in the huge consumer electronics sector, such as for mobile devices, digital still cameras, gaming, and gesture recognition and control and so on. CMOS image sensors can offer high speed, low cost, high dynamic range;and backside illumination can enable better quality imaging in low light and normal lighting conditions.

Key technologies enabling 3D image sensing include time of flight, structured light, noncontact 3D laser scanner, LIDAR, stereovision, interferometry. Machine vision systems employing 3D imaging technologies are in use for applications such as quality control, microprofiling. With companies trying to incorporate gesture recognition capabilities into such devices, 3D image sensors will have a high impact in consumer electronics devices, such as smart phones, tablets, personal computers, home entertainment, among others.

3D vision enables robots to have better perception of their surroundings, which will further help to share the work floor between humans and robots. 3D machine vision can lead to better automation and quality control. 3D image sensors can have key impact in biometrics, such as fingerprint or palm scanning, automotive advanced driver assistance, and security and surveillance (e.g., object tracking and location) applications.

3D image sensors can converge with various technologies, such as LED lighting, machine vision, cameras, software processing, to enable enhanced products and applications, such as advanced robots, autonomous vehicles, environmental awareness, among others. The increased interest in gesture recognition will enable higher adoption of 3D image sensors that the employ time-of-flight principle, which is beneficial for applications requiring a fast response time.

Some of the key non-captive stakeholders in 3D image sensors include Texas Instruments, SoftKinetic, Infineon Technologies, Omnivision Technologies,, Ifm efector Inc., LMI Technologies, Faro Technologies, Teledyne Dalsa, Cmosis, BASF, among others.

From 2012 onwards, the number of patents published has been increasing every year. This indicates growing interest in 3D image sensors and an increase in possibilities of applications in the near- to medium-term. North America is a major market for 3D image sensors, particularly in consumer electronics. The most number of patents has been published in United States, but the top assignees, such as LG, Samsung, and Sony, are based in the APAC region. A lot of research has been targeted toward defense applications. Research in the European region is mainly spearheaded by universities and research institutes.

A recent patent in 3D image sensing powered by robot vision hand-eye relation calibration (CN103925879) is assigned to HEFEI Institutes of Physical Science, Chinese Academy of Sciences, pertains to an indoor robot vision hand-eye relation calibration method based on a 3D image sensor.

Patents indicate that research is geared toward improved fabrication of 3D image sensors as well as applications for such sensors. For example, Patent CN103925879, assigned to HEFEI Institutes of Physical Science, Chinese Academy of Science,

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Indoor robot vision hand-eye relation calibration method based on 3D image sensor	16.07.2014; CN103925879	HEFEI Institutes of Physical Science, Chinese academy of sciences	KONG LINGCHENG	The invention provides an indoor robot vision hand-eye relation calibration method based on a 3D image sensor. The method comprises the following steps: S1, marking a plurality of marking points on hand grabbing tail end joints of a robot, acquiring point cloud image information of the hand grabbing tail end joints through the 3D vision sensor of the robot, and acquiring a plurality of sets of three-dimensional coordinate values relative to a visual sensor coordinate system; S2, acquiring the three-dimensional coordinate values of the multiple marking points of the hand grabbing tail end joints under the world coordinate system through an external three-dimensional measurement device, wherein the values are acquired through an arm-base coordinate system of the robot; S3, acquiring the coordinate values through the step S1 and the step S2 and obtaining a hand-eye calibration array. The indoor robot vision hand-eye relation calibration method based on the 3D image sensor simplifies the calibration process, the measurement precision is high, and the requirement for indoor robot hand-eye calibration can be effectively met.
System and method for fabricating a 3D image sensor structure	22.05.2014; US20140138752	Taiwan Semiconductor Manufacturing Company, Ltd.	Kao Min-Feng	A system and method for fabricating a 3D image sensor structure is disclosed. The method comprises providing an image sensor with a backside illuminated photosensitive region on a substrate, applying a first dielectric layer to the first side of the substrate opposite the substrate side where image data is gathered, and applying a semiconductor layer that is optionally polysilicon, to the first dielectric layer. A least one control transistor may be created on the first dielectric layer, within the semiconductor layer and may optionally be a row select, reset or source follower transistor. An intermetal dielectric may be applied over the first dielectric layer; and may have at least one metal interconnect disposed therein. A second interlevel dielectric layer may be disposed on the control transistors. The dielectric layers and semiconductor layer may be applied by bonding a wafer to the substrate or via deposition.
3D image sensor and method of fabricating same	23.04.2014; KR1020140047934	Samsung Electronics Co. Ltd.	LEE, KWANG MIN	Provided are a 3D image sensor and a method of fabricating the same. In the 3D image sensor, because the thickness of a second transmission gate and the gate insulating layer of a drain gate is thinner than that of other gate insulating layers, the operation voltage of the second transmission gate and the drain gate can be lowered. Thereby, the power consumption of the 3D image sensor can be reduced. COPYRIGHT KIPO 2014
System and method for fabricating a 3D image sensor structure	13.02.2014; US20140042445	Kao Min-Feng.	Kao Min-Feng	A system and method for fabricating a 3D image sensor structure is disclosed. The method comprises providing an image sensor with a backside illuminated photosensitive region on a substrate, applying a first dielectric layer to the first side of the substrate opposite the substrate side where image data is gathered, and applying a semiconductor layer that is optionally polysilicon, to the first dielectric layer. A least one control transistor may be created on the first dielectric layer, within the semiconductor layer and may optionally be a row select, reset or source follower transistor. An intermetal dielectric may be applied over the first dielectric layer; and may have at least one metal interconnect disposed therein. A second interlevel dielectric layer may be disposed on the control transistors. The dielectric layers and semiconductor layer may be applied by bonding a wafer to the substrate or via deposition.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Pixel unit of 3D CMOS image sensor	29.01.2014; CN103545334	Shanghai Integrated Circuit Research & Development Center	Chen Jiayin	The invention discloses a pixel array of a 3D CMOS image sensor, and belongs to the field of integrated circuits. The pixel array of the 3D CMOS image sensor comprises a substrate, a metal layer, a micro-lens layer and a shading layer in sequence from bottom to top, wherein a sensor layer is arranged in the substrate, the substrate is used for carrying out photovoltaic conversion on incident light in an optical channel, the metal layer is used for transmitting electrical signals of the photovoltaic conversion to a peripheral circuit so that processing can be carried out on the electrical signals, the micro-lens layer is used for carrying out focus on light which irradiates the interior of the optical channel to form the incident light, the shading layer is used for enabling the direction of incident light sensed by the portions, of pixels on columns with odd serial numbers, of the sensor layer and the direction of incident light sensed by the portions, of pixels on columns with even serial numbers, of the sensor layer to be distributed on the two sides of the normal direction of a pixel array body respectively, and therefore a digital image simulating the channel of the left eye and the channel of the right eye is formed through processing of the peripheral circuit. According to the pixel array of the 3D CMOS image sensor, 3D vision is achieved on the basis of a single image sensor, and the cost of the 3D vision is reduced.
Image sensor with optical filters having alternating polarization for 3D imaging	25.07.2013; US20130188023	Kuang Jiangtao	Kuang Jiangtao	An image sensor for three-dimensional ("3D") imaging includes a first, a second, and a third pixel unit, where the second pixel unit is disposed between the first and third pixel units. Optical filters included in the pixel units are disposed on a light incident side of the image sensor to filter polarization-encoded light having a first polarization and a second polarization to photosensing regions of the pixel units. The first pixel unit includes a first optical filter having the first polarization, the second pixel unit includes a second optical filter having the second polarization, and the third pixel unit includes a third optical filter having the first polarization
3D image sensor capable of implementing a color sensor and an electronic system including the same	07.02.2013; KR1020130014222			PURPOSE: A 3D image sensor and an electronic system including the same are provided to improve performance by vertically laminating a color filter and an organic photoconductive conversion layer for sensing depth information. CONSTITUTION: A unit pixel(100) includes a color filter(150) and an infrared sensing part. The color filter selectively absorbs visible light and converts the light into electricity. A readout circuit reads out the image information sensed from a pixel array. An infrared sensing part includes a first electrode(141), a second electrode(142), and an organic photoconductive conversion layer(130). The organic photoconductive conversion layer is formed between the first electrode and the second electrode. The visible light passes through the organic photoconductive conversion layer, and infrared light is selectively absorbed for photoelectric conversion. COPYRIGHT KIPO 2013 null

Exhibit 1 lists some of the patents related to 3D image sensor.

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