TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

30 January 2015

1. ENERGY HARVESTERS AND SENSORS ENABLE SMART SHOES

In the sports arena, competition is becoming increasingly intense and technology is helping athletes in tracking and analyzing their performance and finding ways to improve it. As there is keen interest in the field of sports, many companies are working on developing or incorporating sensors in shoes, making them smart and intelligent, including smart shoes with force sensors, which Nike has investigated. However, earlier work has tended to involve smart shoes powered by batteries, which would require maintenance, thus escalating maintenance cost. There is a need for a device that can self-power sensors inside shoes, making them smart and reducing maintenance costs. The device should be easy to deploy and light in weight besides being cost effective.

To address the above challenge, researchers from the Hahn-Schickard-Gesellschaft Institute of Micromachining and Information Technology in Germany have developed smart shoes, which are deployed with energy harvesters, such as shock and swing harvesters as well as temperature and accelerometer sensors and wireless transmitters.

The energy harvester in the smart shoe comprises stacks of magnets and coils of wire. The shock and swing harvester works on the principle of electromagnetic induction. When the wearer either walks or runs, the magnetic field within the coil changes. Due to the changing magnetic field, a charge or voltage is created; this further powers the electronic devices such as the accelerometer sensor and the temperature sensor. This self-powered sensor makes the shoe smart and helps to monitor the performance of athletes. The shock harvester generates power when the heel hits the ground and exerts pressure on the coil, while the swing harvesters generate power when the foot swings back and forth.

Apart from being deployed in shoes of players from various fields of sports, it has opportunities to be deployed in the rackets of tennis and badminton players to track their performance. There are many applications for energy harvesters and sensors. The researchers are currently identifying other applications for this technology.

The project was self-funded by Hahn-Schickard-Gesellschaft Institute of Micromachining and Information Technology. The researchers are currently working on optimizing the energy harvester to convert more energy from human effort.

Details: Dieter Mintenbeck, Research and Development, Hahn-Schickard-Gesellschaft Institute of Micromachining and Information Technology. Wilhelm-Schickard-Straße 10D-78052 Villingen-Schwenningen, Germany. Phone: +49-7721-943-168. E-mail: dieter.mintenbeck@hsg-imit.de. URL: www.hsg-imit.de

2. RADIO SENSOR CHIP ENABLES SMART BUILDINGS

Modern day devices are becoming increasingly smart, helping to drive development of smart buildings. There are sensors available in the market to make the inside environments of buildings smart and intelligent. The sensors available can, for example, detect changes in temperature and can even monitor unauthorized access in buildings. However, these sensors come with the hassle of wires and batteries, which need to be charged regularly. Due to this, the sensors have certain limitations, such as the requirement for regular maintenance. In addition, wire length can be cumbersome and put limitations on the places where the devices can be installed. There is a need for a device that is capable of self-charging and transmitting the signal without wires to the base station. The device should be easy to use and cost effective.

To address the above challenge, researchers from the Fraunhofer Institute for Microelectronic Circuits and Systems IMS have developed a radio sensor chip to monitor windows and check if they are kept open for long periods of time. This radio sensor chip can also monitor intruders trying to enter houses through windows.

The radio sensor chip developed by Fraunhofer Institute for Microelectronic Circuits and Systems IMS is deployed with magnetic and acceleration sensors. The chip is coated with solar cells, which help to power the sensor chip. The radio sensor chip is ten millimeters thick. It is deployed between the window glass and the outer pane. The sensor chip can withstand darkness for 30 hours. Depending on user preference, the sensor chip can be put on sleep mode or it can be adjusted to sleep and awake at intervals of minutes or seconds. With the help of a radio, the sensor chip can send a signal to the base station in case a window is opened for the long time or there is unauthorized access. When the disturbance is detected, the sensor chip sends the signal to the base station within a tenth of a second and triggers the alarm.

Once the product is successfully commercialized, it has opportunities to be deployed in buildings in the future to monitor differences in temperature or suggest the need for ventilation in the house. The sensor can differentiate between various fluctuations such as ball slamming against the window pane or someone trying to break a window. The researchers are currently working on improving the chip and identifying different application areas.

The project was self-funded by the Fraunhofer Institute for Microelectronic Circuits and Systems IMS. Once the project is successfully commercialized, it has opportunities to get a good response from the building industry, making buildings more smart and intelligent.

Details: Michael Bollerott, Public Relations, Fraunhofer Institute for Microelectronic Circuits and Systems IMS, Finkenstr 6147057 Duisburg, Germany. Phone: +49-203-3783-227. E-mail: micbollerott@fraunhofer.ims.com. URL: www.fraunhofer.de

3. WEARABLE SILVER NANOWIRE SENSORS

In the healthcare and consumer electronics industries, wearable devices are gaining strong traction, and sensors are being deployed in wearable devices. There are numerous devices available in the market to monitor electrophysiological signals, but these devices tend to be deployed with wet electrodes. These electrodes require a gel for close contact with the patient's body which can further cause irritation if kept in contact for a long time. There is constant evolution in the development of sensors for monitoring electrophysiological signals. Sensors with dry electrodes are available in the market; however, they are not placed in close contact with the patient's body, which reduces the accuracy of the results. There is a need for a device that would be in close contact with the patient's body and provide accurate results. In addition, the device should also be capable of monitoring signals when the patient is moving and it should be easy to use and cost effective.

To address the above challenge, researchers from North Carolina State University have developed a wearable nanowire sensor for monitoring electrophysiological signals such as electromyography (EMG) and electrocardiography (EKG).

The nanowire sensor uses transparent silver nanowire (AgNW) conductive electrodes. The electrodes deployed in the nanowire sensors are dry in nature and do not require a gel to get in contact with the human body. This further reduces the irritation caused by wet electrodes available in the market and can be kept in constant touch with the human body for long periods. The researchers have incorporated silver nanowire electrodes with a polyethoxysiloxane polymer film. The polyethoxysiloxane stretchable polymer film is used to increase conductivity by 1-2 orders of magnitude and to provide excellent resistance to oxidation. The nanowire sensor is flexible in nature and can be used for patients in motion. The silver nanowire wearable sensor can be deployed on the patient's body to monitor electrophysiological signals more accurately and easily.

The silver nanowire wearable sensor can be used for monitoring electrophysiological signals, such as EMG and EKG. It can also be employed in prosthetics to respond to the muscular signals of patients. The researchers are currently identifying various applications that can be enabled by the wearable nanowire sensor.

The project was supported by ASSIST Engineering Research Center under a grant from the National Science Foundation. The researchers are currently identifying ways to reduce the overall manufacturing cost.

Details: Dr. Yong Zhu, Associate Professor, Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, NC 27695. Phone: 919-513-7735. E-mail: yong_zhu@ncsu.edu. URL: www.ncsu.edu/

4. RECENT PATENTS IN THE FIELD OF IMAGE SENSORS

Image sensors that convert optical images into electrical signals are called image sensors; and are widely used in digital cameras and digital camera modules. The consumer segment is the largest market for image sensors. There is an increase in demand for high megapixel, high resolution cameras for smart phones and tablets.

The two main types of image sensors available in the market are charged coupled device image sensor and complementary metal oxide semiconductor (CMOS) image sensor. CMOS image sensors are easy to integrate, with fast frame rates and low power consumption, CMOS sensors are mainly used in high-volume applications.

Image sensing is seeing growth in industries, such as automotives and consumer electronics. In addition, image sensing has expanding opportunities in applications, such as robotics, fingerprint scanners, virtual keyboards, infrared night vision, park assist or self-parking cars, lane departure warning/lane change assist, wireless endoscope capsules, and digital intraoral cameras, among others. Research is being conducted for further development of image sensors. Companies are focusing on resolution, pixel count, and size to further improve the performance of image sensors.

A recent patent in image sensing powered by a photoelectric conversion unit (WO/2015/008797) is assigned to Fujifilm Corporation. This development pertains to a method of manufacturing an image sensor that has an inorganic protective layer on the organic photoelectric conversion unit.

In 2015, approximately 64 patents have been registered under image sensing. In total, approximately 122522 patents have been registered under image sensing. In which approximately 56 patents were registered in Africa which includes Egypt, Kenya, Morocco, and South Africa; approximately 31889 patents were registered by America which includes USA and Canada; approximately 27712 were registered by the European Patent office; approximately 11534 patents were registered by China; approximately 34729 patents were registered by Japan; approximately 14912 were registered by the Republic of Korea; approximately 110 patents were registered by Israel; approximately 479 patents were registered by Russia and many more have been registered under image sensing from different parts of the world.

Some of the participants investing in image sensing R&D include Samsung Electronics Co., Ltd., Apple Inc., LG Electronics INC, Intel Corporation, Google Inc., Panasonic Intellectual Property Corporation OF America, Sony Corporation, Mitsubishi Electric Corp, STMicroelectronics, Teledyne DALSA, Toshiba Corporation, ON Semiconductor, OmniVision Technologies, Inc., among others.

Title	Publication Date/ Publication Number	Assignee	Inventor	Abstract
IMAGE SENSOR AND METHOD FOR MANUFACTURING SAME	22.01.2015; WO/2015/008797	FUJIFILM CORPORATION	MURO, Naotsugu	A method for manufacturing an image sensor having (a) color filter pixels, (b) an inorganic protective layer, (c) an organic photoelectric conversion unit, and (d) an inorganic photoelectric conversion unit; wherein the method for manufacturing an image sensor has a step for providing the (b) inorganic protective layer on the (c) organic photoelectric conversion unit.
BACKLIT IMAGE SENSOR AND MANUFACTURING METHOD THEREFOR	22.01.2015; WO/2015/007182	GALAXYCORE SHANGHAI LIMITED CORPORATION	ZHAO, Lixin	Provided are a backlit image sensor and a manufacturing method therefor. The backlit image sensor comprises: a silicon wafer layer (1), which comprises a photodiode (101) used for photoreception and for generating an electrical signal, where the silicon wafer layer (1) is provided with a front surface and a rear surface; a backend layer (2), which is arranged on the front surface of the silicon wafer layer (1), where the backend layer (2) comprises a transistor gate electrode, a gate oxide layer, lead layers (203 and 204), and dielectric layers (2011 and 2012); and, a light incidence layer (3), which comprises a micro-lens layer (301) and an optical filter film layer (302), where the light incidence layer (3) is arranged at the rear surface of the silicon wafer layer (1). The backend layer (2) also comprises: a light absorbing layer (202), which is arranged at a predetermined position in the backend layer (2), where the light absorbing layer (202) is used for absorbing a light transmitted from the silicon wafer layer (1). As the light transmitted from a component layer is absorbed via the light absorbing layer (202) that is employed, the probability of the transmitted light being reflected to another pixel is greatly reduced, thus reducing crosstalk between adjacent pixels.
IMAGE SENSOR AND METHOD FOR MANUFACTURING SAME	15.01.2015; WO/2015/005658	RAYENCE CO., LTD	KIM, Tae Woo	The present invention aims to provide a means for reducing the leakage current of a photoconductor using Cd(Zn)Te and the like. Provided is an image sensor comprising, on a substrate: a photoconductor comprising a photoconductive layer made of CdTe or CdZnTe, and a doping layer containing a doping substance on the substance forming the photoconductive layer; and an upper electrode on the photoconductor.

IMAGE SENSORS AND METHODS OF MANUFACTURING THE SAME	27.11.2014; US20140349437	Samsung Electronics Co., Ltd.	HISANORI Ihara	In image sensors and methods of manufacturing the same, a substrate has a photoelectric conversion area, a floating diffusion area and a recess between the photoelectric conversion area and the floating diffusion area. A plurality of photodiodes is vertically arranged inside the substrate in the photoelectric conversion area. A transfer transistor is arranged along a surface profile of the substrate having the recess and configured to transfer electric charges generated from the plurality of photodiodes to the floating diffusion area. The transfer transistor includes a gate insulation pattern on a sidewall and a bottom of the recess and on a surface of the substrate around the recess, and a gate conductive pattern including polysilicon doped with impurities and positioned on the gate insulation pattern along the surface profile of the substrate having the recess, wherein a cavity is in an upper surface of the gate conductive pattern.
IMAGE READING APPARATUS PROVIDED WITH IMAGE SENSOR CONTAINED IN SLIDABLE CARRIAGE	30.10.2014; US20140320936	Brother Kogyo Kabushiki Kaisha	OSAKABE Yoshinori	An image reading apparatus includes: a contact glass setting a manuscript thereon; an image sensor extending in a first direction and having a reading surface which faces the contact glass for reading an image from the manuscript on the contact glass; a rail member extending inside the apparatus main body in a second direction perpendicular to the first direction; a carriage having a sensor container to contain the image sensor, a taper end portion formed in an end portion in the first direction to become smaller in height toward the end side, and an opening formed in the bottom of the sensor container on the taper end portion side; a biased portion adjacent to the reading surface of the image sensor in the second direction; and a biasing member biasing the image sensor toward the contact glass via the biased portion.
METHOD OF MAKING INTERPOSER PACKAGE FOR CMOS IMAGE SENSOR	30.10.2014; US20140322856	Optiz, Inc	Oganesian Vage	An image sensor package and method of manufacture that includes a crystalline handler with conductive elements extending therethrough, an image sensor chip disposed in a cavity of the handler, and a transparent substrate disposed over the cavity and bonded to both the handler and image sensor chip. The transparent substrate includes conductive traces that electrically connect the sensor chip's contact pads to the handler's conductive elements, so that off-chip signaling is provided by the substrate's conductive traces and the handler's conductive elements.

Vertically Stacked Image Sensor	30.10.2014; US20140320718	Apple Inc.	Fan Xiaofeng	A vertically stacked image sensor having a photodiode chip and a transistor array chip. The photodiode chip includes at least one photodiode and a transfer gate extends vertically from a top surface of the photodiode chip. The image sensor further includes a transistor array chip stacked on top of the photodiode chip. The transistor array chip includes the control circuitry and storage nodes. The image sensor further includes a logic chip vertically stacked on the transistor array chip. The transfer gate communicates data from the at least one photodiode to the transistor array chip and the logic chip selectively activates the vertical transfer gate, the reset gate, the source follower gate, and the row select gate..

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

Picture Credit: Frost & Sullivan

Back to TOC