TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

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1. MULTISPECTRAL IMAGING SYSTEM WITH REDUCED FOOTPRINT

Multispectral imaging captures images or video streams from multiple spectral bands simultaneously. This is normally done using different cameras for obtaining specific spectral information. However, this setup takes up a lot of space, power, and also leads to a costly system. Multispectral cameras that consist of a single sensor tend to use different filters, which reduce the size of the system, but simultaneous makes it difficult to capture images and video streams.

FluxData Inc, USA, has addressed these challenges by building a system that reduces the space and power consumption and at the same time enables forming of multispectral images and video streams with data collected simultaneously. The camera, FD-3SWIR uses InGaAS (indium gallium arsenide) sensors that are suitable for wavelengths beyond the visible spectrum. It also uses customized filters that enable the camera to sense data from visible, near infrared (NIR) and short wave infrared (SWIR) spectrums simultaneously. The FD-3SWIR has a common aperture for three different sensors. The camera integrates specific filters for each of the three InGaAs sensors and collects information at the same time. When the information from the sensors is processed, all the frames are synchronized, which provides video output. Fluxdata has used sensors from Sensors Unlimited, which is a key developer for SWIR sensors and is part of UTC Aerospace Systems. The sensors provide a high resolution of 640 x 512 pixels where each pixel has a pitch of 15 micrometers. The camera provides digital output that enables plug and play connectivity, easy transmission of data and post processing.

Conventional imaging systems that collate images from visible light, NIR, SWIR, MWIR (medium wave infrared) and LWIR (long wave infrared), can require five individual systems with different lenses. FluxData's FD-3SWIR system has been able to reduce this number to just three by having a single system for visible, MWIR and SWIR images. This leads to reducing the processing of the image by 60% and also marked reduction in size and weight of the entire system. The camera can operate in a wide temperature range from -35 degrees C to +71 degrees C and consumes 4.5 W of power.

The potential applications for the FD-3SWIR camera are primarily in defense, security, and surveillance. However, the device is also suitable for medical imaging, machine vision, and research purposes. The major benefit in using this system is the reduced size and processing speed requirements. Thus, the camera can be easily fitted into unmanned aerial vehicles (UAVs) that are being increasingly used for surveillance purpose. Industrial machine vision is also a key area that can benefit from this device. The FD-3SWIR can be used for testing as well as identifying material composition. FluxData collaboratively works with various industry participants to develop specific solutions.

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2. BODY WORN SENSOR FOR ELECTROLYTE MONITORING

Dehydration is a phenomenon that is associated with loss of body water, which leads to a misbalance of electrolytes present in the body--such as sodium, potassium, phosphate, and chlorine. People performing strenuous activities, such as athletes, sportspersons, and soldiers, can benefit by having knowledge of the amount of electrolytes present in the body to prevent occurrences of discomfort resulting from vomiting, cramping of muscles, and so on. The electrolytes are minerals that are necessary for carrying nerve impulses that direct the functioning of muscles and heart.

Researchers at Sandia National Laboratories, USA, have developed a body worn device that uses sensors to monitor the electrolytes present in the human body in real-time. The sensor is small enough to fit in the palm or can also be worn on the wrist. It consists of micro needles that does not cause any discomfort to users when pressed into the skin. The needles draw interstitial fluid, that is, the fluid between skin cells, and analyses it in the device itself. Minute amounts of potassium pass unobstructed through the needles into a cartridge that contains carbon electrodes. The electrodes measure the concentration of the potassium highly selectively. The selectivity of the electrodes can be easily altered to detect other electrolytes such as calcium and sodium. Thus a single device can be used for multi-electrolyte sensing purposes.

Wearable electronics have garnered a lot of interest recently, particularly in applications such as the quantified self and mobile health. Fitness trackers are also emerging and gaining prominence in the market. This innovation has the potential to be accepted largely by military and sportspersons. It can be used for training purposes and also during actual events and on-duty.

A prototype of the device has been created and the organization is currently patenting the sensor. It is expected that the newly developed wearable sensor will be commercialized around 2016. Once commercialized, early adopters are expected to include athletes. In future work, the researchers intend to modify the device in such a way that it would be able to transfer electrolytes when it senses a deficiency of a particular kind. In the device, separate microneedles will either draw the fluid from the skin or transmit electrolytes kept inside the device to the cells. They also intend to modify the needle geometry so that it works perfectly on human skins. The initial sensor development work was funded by the Laboratory Directed Research and Development program of Sandia and the United States Defence Threat Reduction Agency.

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3. TOUCHLESS GESTURE CONTROL USING MUSCLE ACTIVITY SENSORS

Touchless gesture recognition and wearable electronics are key emerging technologies that have the capabilities to provide an immersive, more user-friendly and interesting experience in various applications. Conventionally, computing devices have been controlled using devices, such as keyboards, mouse, and more recently, touch screens. Developers are researching on more natural ways of communicating with electronic devices. Although advanced systems incorporate voice recognition or vision-based gesture recognition, the challenge lies in developing a technology that is able to understand the natural activities of humans and use that as an input for controlling electronic devices or products. Voice recognition systems tend to fail when multiple persons speak or when there is ambient noise interference. Also, in complex applications such as gaming, voice control cannot be used, for instance, in controlling an in-game character. There has been a surge in interest in vision-based systems and they have witnessed fast-paced development. However, they are unable to provide the user with enhanced freedom of movement as these systems have a limited range.

Thalmic Labs, Canada, has addressed these challenges by developing a wearable sensor device that monitors arm muscles and movement to determine gesture inputs. The company's Myo armband consists of electromyography (EMG) sensors that monitor the electrical activity of muscles. The data from the sensors are processed using an onboard ARM Cortex M4 processor in real time and transmitted using Bluetooth 4.0 low energy wireless connectivity to a computer. Using software, the electrical activity is decoded to generate muscle movements, which acts as the input for controlling devices.

Since the device does not use immobile sensors, such as vision sensors or ultrasonic sensors, it allows the user to have the freedom of movement while controlling devices. The device can also be plugged to a computer using micro USB (universal serial bus) port to recharge the lithium ion batteries.

The Myo armband is expected to find considerable interest from game developers. The armband enables immersive gaming experience that was not possible earlier. Apart from gaming the device can be used to control various functions of a computing device. This includes, for example, controlling the music, videos, presentations, and browsing. Myo can also be used in other applications such as controlling of unmanned aerial and ground vehicles.

Thalmic Labs has released an alpha version of the armband for developers, along with a software developer kit. This allows different and innovative application developments using the armband. Thalmic Labs has already attracted funding from venture capitalists such as Spark Capital and Intel Capital. In June 2013, the company had completed a Series A funding round for $14.5 million. The company is expecting to ship the final versions of the Myo to customers in September 2014.

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4. RECENT PATENTS IN THE FIELD OF BRAIN COMPUTER INTERFACE (BCI)

A brain-computer interface (BCI) or mind-machine interface (MMI) is a direct communication channel between the brain and an implanted or external device. BCI enables bi-directional communication between the brain and the device--either the brain can control or monitor the device or the device can control or monitor the brain. BCI devices are used to monitor, aid, enhance, repair, control, or be controlled by, the human cognitive and/or sensory-motor system.

BCI has been gaining some traction for consumer electronics applications in which users can use thoughts to control computing devices such as smartphones, smart televisions, various interactive applications, and so on. There has been a lot of interest in neurogaming where BCI enables users to have an immersive gaming experience. BCI, however has a bigger social impact by enabling assistive technologies and therapies for people affected by diverse medical conditions. BCI has been proven to assist in applications, such as assistive prosthetics, speech assistance, and so on.

Recent patents in this field indicate interest in using electroencephalography (EEG) for sensing electrical activity in the brain. Other promising technologies include electromyography (EMG), magnetoencephalography (MEG), and functional magnetic resonance imaging (fMRI). There is also an effort to make the BCI hardware communicate wirelessly to minimize user discomfort and enable portable applications.

PATENT TITLE	PUBLICATION DATE / NUMBER	ASSIGNEE	INVENTORS	ABSTRACT
METHOD AND SYSTEM FOR A BRAIN-COMPUTER INTERFACE	08.05.2014; WO/2014/069996	STICHTING KATHOLIEKE UNIVERSITEIT	Reuderink, Boris	Method for providing a brain-computer interface, and a brain-computer interface, having a classification model as part of a processing pipeline. The input signal comprises a neural signature to be detected by the classification model. Obtaining the classification model comprises training the classification model using the input signal and assigning one or more labels to the input signal at different time points. Each label indicates whether the input signal at the associated time point of the label should be classified as a target activity. Further processing steps are whitening the input signal using whitening parameters to reduce temporal and spatial correlations in the input signal to obtain a whitened time series, specifying a polynomial kernel

				using polynomial kernel parameters,that induces a mapping of the whitened time series to a linearly separable feature space,and classifying the feature space using the output of the polynomial kernel, classification parameters, and weights.
Time Domain-Based Methods for Noninvasive Brain-Machine Interfaces	27.02.2014; US20140058528	Contreras-Vidal Jose L.	Contreras-Vidal Jose L.	A noninvasive brain computer interface (BCI) system includes an electroencephalography (EEG) electrode array configured to acquire EEG signals generated by a subject. The subject observes movement of a stimulus. A computer is coupled to the EEG electrode array and configured to collected and process the acquired EEG signals. A decoding algorithm is used that analyzes low-frequency (delta band) brain waves in the time domain to continuously decode neural activity associated with the observed movement.
A brain-computer interface test battery for the physiological assessment of nervous system health	08.01.2014; EP 2682053	BRAIN COMP INTERFACE LLC	SIMON ADAM JAY	The systems and methods of the present invention comprise a battery of three or more sensory and cognitive challenge tasks which actively or dynamically challenge the brain to monitor its state for assessment of injury, disease, or compound effect, among others. Embodiments of the invention can provide systems and methods for analyzing and assessing a personalized biometric brain health signature by integrating the use of electroencephalography (EEG), somato-sensory, neuropsychological, and/or cognitive stimulation, and novel signal processing and display. Embodiments of the invention can provide systems and methods for early detection of dementia, including Alzheimer's disease (AD), vascular dementia (VAD), mixed dementia (AD and VAD), MCI, and other dementia-type disorders, as well as brain injury states such as mild Traumatic Brain Injury. Embodiments of the invention can provide some or all of the following improvements over conventional systems and methods, including: (1) Increased sensitivity, specificity, and overall accuracy; (2) early detection of disease and injury; and (3) enhanced portability with remote data acquisition capability. The present invention permits the overall assessment of health of the brain. Methods to assess the personalized biometric brain health signature are disclosed.

BRAIN-COMPUTER INTERFACE SYSTEM AND METHOD	30.05.2013; US 20130138011	Ang Kai Keng	Ang Kai Keng	A system and method for brain-computer interface (BCI) based interaction. The method comprising the steps of: acquiring a person's EEG signal; processing the EEG signal to determine a motor imagery of the person; detecting a movement of the person using a detection device; and providing feedback to the person based on the motor imagery, the movement, or both; wherein providing the feedback comprises activating a stimulation element of the detection device for providing a stimulus to the person. The system comprising: means for acquiring a person's EEG signal; means for processing the EEG signal to determine a motor imagery of the person; means for detecting a movement of the person using a detection device; and means for providing feedback to the person based on the motor imagery, the movement, or both; wherein the means for providing the feedback comprises a stimulation element of the detection device for providing a stimulus to the person.
MULTIMODAL BRAIN COMPUTER INTERFACE	29.05.2013; EP 2596416	UNIV WASHINGTON	LEUTHARDT ERIC C	Determining an intended action based on one more cortico-physiologies within brain signals includes establishing communication with one or more electrodes for sensing the brain signals of a subject, and concurrently receiving brain signals representative of a plurality of cortico-physiologies. The brain signals are transmitted to a processor for use in determining the intended action and controlling a device.
CELL-PHONE BASED WIRELESS AND MOBILE BRAIN-MACHINE INTERFACE	23.05.2013; US 20130127708	Jung Tzyy-Ping	Jung Tzyy-Ping	Techniques and systems are disclosed for implementing a brain-computer interface. In one aspect, a system for implementing a brain-computer interface includes a stimulator to provide at least one stimulus to a user to elicit at least one electroencephalogram (EEG) signal from the user. An EEG acquisition unit is in communication with the user to receive and record the at least one EEG signal elicited from the user. Additionally, a data processing unit is in wireless communication with the EEG acquisition unit to receive and process the recorded at least one EEG signal to perform at least one of: sending a feedback signal to the user, or executing an operation on the data processing unit.

BRAIN-COMPUTER INTERFACE DEVICES AND METHODS FOR PRECISE CONTROL	18.04.2013; US 20130096453	CHUNG Chun Kee	CHUNG Chun Kee	A brain-computer interface device and method for controlling the motion of an object is provided. The brain-computer interface device includes a brain wave information processing unit, which receives converted brain wave information including object motion information, extracts object control information including the object motion information from the converted brain wave information, and transmits the extracted object control information to a hybrid control unit, and a hybrid control unit which receives target information including target location information of a target and outputs final object control information obtained by correcting the object control information including the object motion information based on the target information

Exhibit 1 lists some of the recent patents related to BCI.

Picture Credit: USPTO/Frost & Sullivan

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