TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

27th March 2015

1. SMART TEXTILES FOR ATHLETES

Wearable devices are gaining strong traction in various industries, such as healthcare, consumer electronics, prosthetics, sports and many more. Sensors are an important part of wearable electronics. At present, the wearable devices available in the market can be somewhat bulky and sensitive to moisture; they contain numerous sensors, making the device more complicated and uncomfortable for the wearer to use it on the body for long periods of time.

To address the above challenges, researchers from a UK-based product design and development firm, Cambridge Consultants Ltd., have developed innovative wearable technology, that is, a novel smart textile that turns garments into active motion sensors. The company is calling the smart textile Xelflex.

The key ingredients used by Cambridge Consultants to develop Xelflex are a fiber optic sensor, low-cost impulse radar, and a software algorithm. The optical fiber is integrated into garments and behaves like a thread in the garment. As the thread is robust, it can be used in sportswear. In addition, a small credit card sized electronics pack is the other component which will be integrated in the garment. When the optical fiber bends, there is a change, or increase, in reflection and scattering. Xelflex measures the scattering of light in optical fibers. The extra scattering is picked up by Xelflex which further measures how much of the joint is bent. With the help of the software algorithm, the result from the sensor is switched from raw data to intelligent data and is further useful for the wearer. Xelflex will monitor the change in posture and movement and record the data which will help the wearer to overcome his/her challenges.

The immediate application of Xelflex is in sports to measure joint angles in various scenarios, such as in golf swing, tennis serve or ski techniques. The raw joint motion data is then processed into smart data which gives intelligent feedback. Xelflex will be the coach which helps to improve one's game technique by recording the body motions in the training session, which are later compared

to help make improvements in the game and any bad habits identified can be overcome over a certain period of time. Xelflex is still in the early stages and the company is looking to work with fashion and design companies which will help them to integrate their fiber optics technology in appropriate sports clothing.

The project was self-funded by the company. With extensive experience in industrial low-cost impulse radar and fiber-optic sensors, the developers have built Xelflex. The researchers are currently working on identifying different applications of the device. Once the device is successfully commercialized, it is expected to be used for sports clothing. As the device can be manufactured cost efficiently, it is expected to be well received in the market.

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2. WEARABLE DEVICE TO INTERACT WITH DIGITAL ENVIRONMENTS

Wearable technology and sensors integrated in wearable devices have been gaining significant market traction. According to a recent Frost & Sullivan analysis, the wearable sensors market totalled $76.0 million in 2013 and is projected to reach $800 million in 2020. Wearable devices integrated with sensors are becoming smarter and more advanced. Wearable devices are being widely used in the consumer electronics and healthcare market. The healthcare market for wearable devices is very competitive. Rapid developments have been witnessed in the consumer electronics market.

An Israel-based company, MUV Interactive, has developed a wearable device based on finger movement sensing to interact with the digital environment. The device, named Bird, can turn each and every surface into an interactive touchable screen with the help of voice, motion, and touch.

The key ingredients used to develop Bird are a biocompatible material, touch and motion sensor, software algorithm and Bluetooth. Bird is a ring-like device that can fit on all the fingers. Because of the elastic property of the biocompatible material, the ring can fit any finger size. In addition, the device is easy to wear on fingers and comfortable enough to stay on the finger for a long time. The Bird is packed with a variety of sensors to sense the movement of the fingers. In

addition, it uses the software algorithm to turn the raw data into meaningful information. The Bird turns displays into touch screens and enables the user to touch any of the devices remotely with the help of Bluetooth, allowing interaction between entire spectrums.

Once the bird is successfully commercialized, it will sense the movements of the finger. Using the Bird, users can answer the phone by simply tapping on the chair. In addition, it will allow users to watch TV on the kitchen counter. The Bird will enable enhanced living with the help of Internet-of-Things. As MUV Interactive is an early mover in this domain, the company is expected to capture significant market share.

The project was funded by Asian venture capitalists and Israeli Venture capitalists. The Israeli Ministry of Economy also funded the project. In addition, the company has generated $2.5 million through a crowd funding platform called Our Crowd. The Bird is expected to be commercialized between the second and third quarter of 2015. Once the product is successfully commercialized, it will widely adopted due to its ability to convert any surface into a touch screen. The technology base of Bird is highly scalable, and the company is planning to launch another product called Sphere. The Sphere will be installed on the ceiling and project the content from connected devices.

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3. PENCIL AND PAPER ENABLING GRAPHITE-BASED STRAIN SENSOR

Flexible and printed electronic devices have promising potential in structural health monitoring and wearable devices. Many sensors can be integrated in devices to monitor changes in structures or changes in the movements of the user. The number of sensors integrated into the device is directly proportional to the total cost of the device. There is a need for new sensors that are inexpensive to manufacture as well as easy to use and integrate. In addition, the sensor should be sensitive enough to monitor changes in the structure or movements of the body.

To address the above challenges, researchers from the Beijing University of Science and Technology have developed a graphite-based strain sensor using pen and paper.

The researchers have used pencil and flexible printing paper to draw graphite-based strain sensors. The sensors drawn on paper conduct electricity and in addition have high resistance. As the paper or sensor bends, the resistance of the sensor either increases or decreases. The precise angle of the bend can be detected by measuring the resistance. The strain sensors are operated with two batteries of 3V. Micro cracks have a major influence on the function of the strain sensor. The graphite-based strain sensors are useful in monitoring human motion and structural changes with a response time of 110 ms and stability of greater than ten thousand unbending and bending cycles. The pen on paper approach can be further used to develop an environmental friendly and economically portable lab on paper, which can be further useful to fabricate multifunctional devices.

The graphite-based strain sensors are expected to be used as wearable sensors, wearable rheostats, and as alarm devices to trigger when doors or windows or books are opened. The sensors can find application in structural health monitoring systems and smart robotics, as multifunctional materials. The graphite-based sensor is very sensitive and cost efficient. These sensors could reduce the cost of sensor manufacturing. As the process is very easy and inexpensive, it can be carried out by an individual according to the need. This method can be used in situations where resources are limited.

The project was self-funded by the Beijing University of Science and Technology. The researchers are currently working on identifying applications for graphite-based strain sensors. Once the device is successfully commercialized, it is expected to be widely adopted in the consumer electronics market.

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4. RECENT PATENTS IN THE FIELD OF WEARABLE SENSING

Sensors are increasingly finding their way into most objects. Further sensor integration into textiles and shoes opens up new avenues of opportunity for participants across the entire ecosystem. Sensors are the back-bone of any wearable device. Different types of wearable devices make the wearable market more complex than a smart phone or a television ecosystem. Products are very different from each other; a wrist-worn fitness band is certainly different from a smart watch which is also worn on a wrist.

The wearable market is witnessing a series of new product launches, such as smart watches, fabrics, and glasses; and the market as a whole is witnessing partnerships, acquisitions, mergers, convergence, and collaboration across the value chain. Innovations are expected to make wearable electronics better in terms of connectivity, use of data, and, ultimately, make them smarter than ever. Wearable devices need to work harmoniously as they are worn on the body; besides, they should be light, comfortable, unobtrusive, and attractive.

A number of start-ups and smaller companies are entering this market but they do not have the expertise in hardware and software required to be successful. Heavyweights such as Apple, Google, Intel, and Microsoft are investing heavily in wearable electronics. These companies are strong enough to drive the wearable electronics industry.

Due to increasing investments in research and development (R&D), there will be numerous types of sensors used in wearable devices over the next 5 years, such as low-power gas sensor arrays that provide information about hazardous gases for enhanced health and safety, or new radio-frequency identification (RFID) sensors used to track animals.

Wearable electronics will create opportunities for brand manufacturers, sensor platform, and software and component suppliers alike. The long-term prospects of wearable electronics are bright.

A recent patent in wearable sensing, Wearable Display Device Use-based Data Processing Control (WO/2015/034617), assigned to Qualcomm Incorporated, pertains to technologies to control the operation of a host device and wearable display device. The status of the wearable display device is based on feedback from one or more touch sensors.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
WEARABLE DISPLAY DEVICE USE-BASED DATA PROCESSING CONTROL	12.03.2015; WO/2015/034617	QUALCOMM INCORPORATED	RABII, Khosro, Mohammad	Techniques are described for controlling operation of both a host device and a wearable display device connected to the host device based on a use status of the wearable display device. The techniques include automatically determining a use status of a wearable display device based on feedback from one or more touch sensors within the wearable display device that indicates whether the wearable display device is worn by a user. Based on the determined use status, the wearable display device controls its own operation (e.g., controls operation of display screens of the wearable display device, a communication session with the host device, and display processing of data received from the host device). The wearable display device also sends an indication of the use status to the host device. The host device then controls its own data processing for the wearable display device based on the indicated use status.
WEARABLE CONTROLLER FOR WRIST	12.03.2015; WO/2015/033327	BELFIORI, Alfredo	BELFIORI, Alfredo	A human-computer interface comprises a wearable device (302, 503, 603) having a plurality of sensor nodes (103, 301, 601, 602, 501, 401, 402, 404). Each sensor node includes one or more Mechanomyography (MMG) sensors, and additionally optic sensors. A module (103, 403) automatically measures finger gestures generated signals using one or more of said sensors. A module (401, 402 and 404) automatically determines the position and the movement at the wrist level that correspond to one or more specific user finger gestures. A module (403, 405) causes one or more computing devices to automatically execute one or more specific commands corresponding to one or more of the specific user gestures.
SYSTEMS AND METHODS FOR CONTEXT-AWARE TRANSMISSION OF LONGITUDINAL SAFTEY AND WELLNESS DATA WEARABLE SENSORS	26.02.2015; US20150054654	EveryFit, Inc.	Albinali Fahd Khalaf	The present solution provides a system and a method for efficiently transmitting data recorded by a wearable sensor. More particularly, the systems and methods described herein enable the data/context-aware transmission of data. In some implementations, by classifying data into predefined categories and then transmitting the data using a transmitter configuration associated with each of the categories enables improved transmission reliability while also improving battery life.
WEARABLE SYSTEM FOR DETECTING AND MEASURING BIOSIGNALS	05.02.2015; WO/2015/017563	EMOTIV LIFESCIENCES, INC.	LE, Tan	A system for detecting bioelectrical signals of a user comprising: a set of sensors configured to detect bioelectrical signals from the user, each sensor in the set of sensors configured to provide non-polarizable contact at the body of the user; an electronics subsystem comprising a power module configured to distribute power to the system and a signal processing module configured to receive signals from the set of sensors; a set of sensor interfaces coupling the set of sensors to the electronics subsystem and configured to facilitate noise isolation within the system; and a housing coupled to the electronics subsystem, wherein the housing facilitates coupling of the system to a head region of the user.

RF TRANSPARENT WOVEN MATERIAL FOR A WEARABLE DEVICE	29.01.2015; US20150029644	ALCAZAR ROSS	ALCAZAR ROSS	An electronic device wirelessly connected to one or more portal devices for sensing user activities is provided. The electronic device includes an injected molded housing assembled with RF transparent woven material to be worn by the user and plurality of sensors positioned inside the housing for sensing activities of the user. The plurality of sensors for transmitting sensed activities wirelessly to the one or more portal devices. The injected molded housing assembled with RF transparent woven material providing a structural stability to the plurality of sensors and the sensor housing.
WEARABLE HEALTH SENSOR	08.01.2015; WO/2015/001434	SERAPHIM SENSE LTD.	JOROV, Eugene	A monitoring device (24) includes a band (32), configured to fit around an appendage of a human subject (22), and one or more sensors (46, 58, 60, 62) fixed to the band and configured to sense physiological parameters of the human subject. In one embodiment, at least one visible light source (82) is fixed to the band. A controller (64) is fixed to the band and is coupled to receive signals from the sensors and to actuate the at least one visible light source in response to a state of the device. At least one flexible light guide (40) is embedded in an outer surface of the band while extending around at least a part of a circumference of the band when fit around the appendage, and is coupled to receive light from the visible light source and to emit the light from the outer surface in a bright stripe along a length of the light guide.
HUMAN-COMPUTER INTERACTION USING WEARABLE DEVICE	31.12.2014;; WO/2014/205767	VERIZON PATENT AND LICENSING INC.	ZHANG, Guangli	Embodiments of apparatus and methods for human-computer interaction are described. An apparatus for human-computer interaction may have one or more processors, multiple sensors to measure motion of a body part of a user, a communication module to communicate with a remote computing device, and an interpretation module to interpret the motion of the body part of the user to be associated with an indication of a user input to the remote computing device. The components may be encased in a body configured to be worn by the user. Other embodiments may be described and/or claimed.

Exhibit 1 lists some of the patents related to wearable electronics enabled by sensors.

Picture Credit: Frost & Sullivan

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