TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

11th July 2014

1. FITNESS MAT WITH SENSORS AND LED

According to a study published in the *Yoga Journal* (May 17, 2013), yoga is being practiced daily by 20.4 million Americans. Yoga offers both physical and mental benefits. Beginners interested in practicing yoga have to approach a personal tutor or attend classes in a gymnasium. It is not economically feasible to pay for these classes every month for years until and unless a person is doing it the right way. Yoga can also be learnt from online videos offering instructions by yoga gurus. However, users may be unsure that their moves are being performed correctly while practicing yoga with the help of video sessions. There is a need for an economical device that can help users practice yoga perfectly and with less distraction.

To address the above challenge, researchers from a Germany-based company--Lunar Europe--have developed a fitness mat called the Tera mat. It is made of ecofriendly wool and is comprised of light-emitting diodes (LED), sensors, and Bluetooth.

The researchers from Lunar Europe have used a circular shaped mat to synchronize with the natural radius of human emotion during exercise. This shape makes the flow of exercises easier. Sensors and LED lights are used to guide the user through the exercises. The fitness mat glows in two colors--blue and red. The mat is also connected to a Bluetooth-enabled tablet app to illustrate movements and connect to smartphones and tablets. Tera can also be used to record the exercises and share it via various social networking sites.

The researchers have developed the Tera fitness mat for personal yoga exercises without a tutor. It is made of wool and its surface is slip resistant. LEDs help guide the exercises and embedded sensors in the fitness mat track the pressure on the mat and the changes in body movements. The blue LEDs guide the user with body posture. Patterns created by illuminated light are used as data, and this data showcases body stance and posture. Data is shared with the Tera application through Bluetooth. The mat guides the user through different exercises with varying difficulty levels.

The fitness mat will play the role of a personal yoga instructor. The Tera application on the smartphones will contain instructional videos. In the future, the Tera fitness mat will be tuned for Pilates, a set of exercises used in holistic medicine and Capoeira, a martial art technique. The fitness mat will also be used to perform Zumba, a dancing style which incorporates salsa and samba.

The Tera fitness mat is expected to be commercialized in a year’s time. It has potential to be well received in the market as it will waive private tutor costs and can be used anywhere and at any time.

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2. WEARABLE SENSOR REDUCES DROWNING RISK

According to Safekids Worldwide, 88% of child drowning cases occur under some supervision. According to the US National Center for Disease Control, a child drowns in less than 20 seconds and an adult drowns approximately in a minute. Drowning is one of the leading causes of death among children. Devices available currently work on the network disconnection theory. When the sensor is submerged in the water for a long time, it gets disconnected from the network and raises an alarm. This kind of device lacks efficiency and accuracy, and it can possibly blow the alarm when the swimmer is trying something new. There is a need for an accurate and efficient device, which can alert parents or staff before events escalate.

To address the above challenge Aquatic Safety Concepts, USA, has developed a wearable drowning detection sensor called iSwimband. The iSwimband is comprised of lightweight rubber, Bluetooth and a drowning detection sensor.

Aquatic Safety Concepts has developed the iSwimband, an application on an iOS (iPhone operating system) platform to monitor swimmers. One iOS-enabled device is capable of tracking eight iSwimbands. Light weight rubber was used as it is waterproof and flexible and can fit on various head sizes and sinks in water. The Bluetooth and sensor are embedded inside the lightweight rubber. The Bluetooth device is synchronized with the iPhone and iPad to provide real-time updates about a swimmer. The iSwimband has a range of upto 30 meters. The sensor is used to detect the submerged body inside the water for a particular length of time and generates an alert.

The iSwimband was developed to prevent drowning. The iSwimband can be used either as a headband or wristband. It is useful for swimmers and non-swimmers such as two year olds playing near a swimming pool. An application on the ios device showcases three lights green, yellow and red. The green light glows when the swimmer is in active swimming mode. The sensor sends a safe signal via Bluetooth to the ios device. The yellow light illuminates when the swimmer is submerged for a certain period of time. This time is considered as a threshold level time for being underwater. The yellow light is a notification for a potential event. The red light glows when the body is submerged for an extended period of time. Additional time under water after the yellow light illuminates is considered as above the threshold level time or the maximum time the swimmer can stay underwater. Sensor is highly refined; it measures submersion time down to 1/1000th of a second. Thus, sensor detects the critical moment before the event gets out of control and prevents drowning risks.

The iSwimband is tamper proof as electronic devices inside the band are covered with rubber. With the use of iSwimband, the drowning rate is expected to decrease by a huge percentage. iSwimband was invented by a team of three--David Cutler, Tom Healy, and Paul Taylor. The iSwimband can be used in hotels, schools, colleges, and universities having swimming pools in their campuses. It can also be used by parents to keep track of their children in lakes or in their private swimming pools.

The iSwimband has been commercialized and is available in the market. Further research is being undertaken to synchronize iSwimband with Android and Windows-based mobile devices. The iSwimband with just iOS device access may have a limited response, but with Android and Windows access in the coming months, it could witness larger-scale adoption.

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3. CHARACTER ARTICULATION USING A TANGIBLE INPUT DEVICE EMBEDDED WITH SENSORS

Three-dimensional (3D) printing is achieved by using an additive process, where layers of materials are arranged under computer control to make three dimensional objects. There are several 3D printing technologies that use a mouse and keyboard as input devices for designing a 3D model using software. Mouse and keyboard controls do not align with 3D interaction tasks, such as mapping between two bones. The mouse and keyboard are not able to track the movements because it requires frequent clicking, resulting in poor efficiency. There is a need for a reconfigurable device that is tangible and compact in size. It should measure 3D rotations with high accuracy and precision and prevent accidental deformation.

To address this issue, researchers from Eidgenössische Technische Hochschule Zürich (ETH Zurich) University have developed a joystick, which is an input device to pose and move virtual characters in a manner similar to molecule models (physical models representing molecules and their processes). The joystick is a tangible device comprising a Hall sensor, a magnet, a microcontroller and light emitting diodes (LEDs) to articulate three-dimensional (3D) characters with 2D interference.

In collaboration with Autonomous Systems Lab, researchers from ETH Zurich have developed a joystick integrated with flat magnets placed at less than a millimeter away from the sensor to stabilize the effect of magnetic distress. The Hall sensor is employed to measure three Euler's intrinsic angles. The Euler angle is used to describe the orientation of a rigid body. The Hall sensor and permanent magnet pair measures the angle of rotation. Joystick joints are embedded with multi-color LEDs, which are used to indicate powered, initialization and detection modes. The joystick is connected to the host computer through the microcontroller; it is used to power the nodes and transmit data to the host computer.

The researchers have developed a joystick to create a standard skeletal 3D model. Models are formed with the help of modular nodes. These nodes are mechanically moveable joints embedded with sensors. Every move made by a joint creates an angle. These angles are measured by sensors to compute the movements of virtual characters. The splitter in joystick allows branching.

Extensions are used to increase the distance between joints and the splitter. End caps cover the exposed electronic material.

A microcontroller is embedded in each joint. It carries a small amount of memory and stores information such as unique ID, color, and node type. The splitter stores information about connected nodes and the joints store information about the angles. When the joint receives the pulse from the microcontroller, it is passed on to all branches with a unique ID code. The information about the unique ID code with connecting node types is forwarded to the host computer. The host computer thus reconstructs the device on the screen.

The joystick developed by the researchers of ETH Zurich is reconfigurable and also suitable for 2D animation control. In the future, this device can be used to build models, such as humanoid characters to implement in animated movies. This device will build various non-humanoid models.

The innovative joystick is being supported and funded by the European Research Council (ERC), Stavros Niarchos Foundation (SNF) Awards, and Intel Doctoral Fellowship. The researchers are currently working on optimizing the performance and design of the device to make it cost-efficient, smaller and faster in operation. The joystick might be commercialized in one or two years' time. The joystick has potential to be well received by users as it eliminates the use of the mouse and keyboard. It will find application in the animation industry as well as in schools and colleges.

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4. RECENT PATENTS IN THE FIELD OF FIBER OPTIC SENSORS

Fiber optic sensors use an optical fiber as the sensing element (in the case of intrinsic types) or as a means of relaying signals from a remote sensor to the sensing electronics. Advantages of fiber optic sensors include immunity to electromagnetic interference. Fiber optic sensors are available operate with low power and monitor events at a distance of more than twenty kilometers. Such fiber optic sensors can detect acoustic and seismic disturbances. Acoustic disturbances are mechanical waves in solids, gases, and liquids including sounds and vibrations. Seismic disturbances are the vibrations that travel through the earth and release energy, causing earthquakes. Tracking these disturbances has become increasingly important in various applications; for instance, tracking the noise made by a leak in a pipeline or breaking of a wire in a concrete pipe, and noise associated with the infrastructure causing disturbances in communication and electrical cables.

Fiber Bragg grating sensors have variations in the refractive index of the fiber core, which can be used to reflect or block certain wavelengths. Such sensors can measure such parameters as strain, temperature, pressure or vibration. In interferometric sensors, the waves are superimposed to extract information about the waves. Optical interferometry can allow for detecting tiny displacements. There are opportunities to further improve the signal-to-noise ratio, bandwidth and accuracy of fiber optic sensors for disturbance detection.

A recent patent in fiber optic sensing involves the incorporation of an interferometric fiber optic sensor, especialy Michelson or Sagnac interferometer, to sense and detect disturbances. The sensing apparatus also incorporates a location sensor system. The location sensor will help in identify disturbances of interest. In this Patent ,no EP 1747472, assigned to Pure Technologies Ltd., the location sensor system is a fiber optic sensor, such as an OTDR (optical time domain reflectometer) sensor or a Brillouin effect sensor. The patent data reveals interest in areas, such as monitoring of reinforcements in structures.

PATENT TITLE	PUBLICATION DATE / NUMBER	ASSIGNEE	INVENTORS	ABSTRACT
Fibre Optic Sensor Method And Apparatus	18.06.2014; EP 1747472 B1	Pure Technologies Ltd	Paulson Peter O	This invention uses an interferometric fiber optic sensor, particularly a Sagnac or Michelson interferometer, in a first fiber to monitor a sensing length of the first fiber and to detect disturbances. Signals indicating disturbances are classified as being of interest or not of interest, depending on predetermined criteria. Disturbances of interest can be, for example, the breaking of reinforcement wires in concrete pipe, the breaking of wires in suspension cables, a fire, a pipeline leak, or an intrusion. A location sensor system is used to determine the location of disturbances of interest, and to confirm

				the interferometer signal to reduce noise. The location sensor system is a fiber optic sensor, such as a phase OTDR sensor or a Brillouin effect sensor, which can detect the location of events it senses. It is present either in the first fiber or in a separate fiber laid adjacent the first fiber along its sensing length, as for example in the same optical cable.
Shape Sensing Using A Multi-core Optical Fiber Having An Arbitrary Initial Shape In The Presence Of Extrinsic Forces	10.06.2014; US 8746076 B2	Rogge Matthew D, Moore Jason P, Nasa	Rogge Matthew D, Moore Jason P	Shape of a multi-core optical fiber is determined by positioning the fiber in an arbitrary initial shape and measuring strain over the fiber's length using strain sensors. A three-coordinate p-vector is defined for each core as a function of the distance of the corresponding cores from a center point of the fiber and a bending angle of the cores. The method includes calculating, via a controller, an applied strain value of the fiber using the p-vector and the measured strain for each core, and calculating strain due to bending as a function of the measured and the applied strain values. Additionally, an apparent local curvature vector is defined for each core as a function of the calculated strain due to bending. Curvature and bend direction are calculated using the apparent local curvature vector, and fiber shape is determined via the controller using the calculated curvature and bend direction.
Apparatus And Method For Chemical Deposition On A Rod Member In An Optical Fibre Manufacturing Process	27.05.2014; US 8733131 B2	Cocchini Franco, Schiaffo Antonio, Rossi Alessandro, Prysmian Cavi Sistemi Energia	Cocchini Franco, Schiaffo Antonio, Rossi Alessandro	An apparatus and method for chemical deposition on a rod member having a support structure for supporting the rod member substantially coaxial to a deposition axis; a burner for depositing chemical substances on the rod member; and a rotation device for imparting a rotation motion to the rod member. The rotation device has a joint member of a type suitable to transmit torque between two misaligned members, for example, a double universal joint or a flexible joint, positioned between a motor and a rod gripping member.
Optical Inspection Apparatus And Method	13.05.2014; US 8723945 B2	Lessard Denis, Quebec Centre Rech	Lessard Denis	An optical apparatus and method for simultaneously scanning the profile of at least two adjacent surfaces of an article such as a wooden board moving along a travel path axis passing through an inspection area

		Ind		located at a central plane transverse to the travel path axis, involve first and second scanning zones sufficiently spaced one with another along the travel path axis to substantially prevent mutual scanning interference between the profile sensors used, while providing a compact arrangement of profile sensors. For so doing, one the first sensing field and the first laser beam of the first profile sensor is crossing the central plane toward the other one of the first sensing field and the first laser beam, and one the second sensing field and the second laser beam of the second profile sensor is crossing the central plane toward the other one of the second sensing field and the second laser beam.
Superfine Fiber Creating Spinneret And Uses Thereof	13.05.2014; US 8721319 B2	Lozano Karen, Sarkar Kamalaksha, Univ To Texas System Board Of Regents	Lozano Karen, Sarkar Kamalaksha	Apparatuses and methods for the production of superfine fibers
Strain Sensing With Optical Fiber Rosettes	06.05.2014; US 8714026 B2	Froggatt Mark E, Gifford Dawn K, Intuitive Surgical Operations	Froggatt Mark E, Gifford Dawn K	One or more mechanical parameters of a structure subjected to a force or condition are measured using distributed, optical fiber sensing technology. At least a curved portion an optical fiber having is attached to an object. A distributed, optically-based, strain sensing technique is used to determine strain information associated with multiple points along the curved portion of the fiber. The determined strain information is processed to generate one or more representations of one or more of the following: an expansion of the object, a thermal gradient associated with the object, or a stress-induced strain at multiple locations on the object corresponding to ones of the multiple points. An output is generated corresponding to the representation.

Optical Fiber Instrument System For Detecting And Decoupling Twist Effects	22.04.2014; US 8705903 B2	Younge Robert G, Ramamurthy Bhaskar S, Tanner Neal A, Schlesinger Randall L, Udd Eric Koninkl Philips Nv	Younge Robert G, Ramamurthy Bhaskar S, Tanner Neal A, Schlesinger Randall L, Udd Eric	An instrument system that includes an elongate body, an optical fiber, and a detector is provided. The elongate body is capable of being twisted. The optical fiber includes a first portion coupled to the elongate body and a second portion having a curved shape adapted to reduce transfer of twisting or bending from the elongate body to the second portion, the second portion having a strain sensor provided thereon. The detector is coupled to the optical fiber and adapted to receive a signal from the strain sensor.

Exhibit 1 depicts recent patents in the field of fiber optic sensors.

Picture Credit: USPTO/Frost & Sullivan

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