TECHNICAL INSIGHTS

SENSOR

TECHNOLOGY ALERT

17th April 2015

1. SENSORS ENABLE NOISE REDUCTION TECHNOLOGY

Some of the recent innovations based on speech recognition and understanding include Google Voice, Siri, and Google glass. The speech recognition qualities of these technologies are good in a quiet environment. However, these technologies can find it difficult to exactly recognize speech when there is associated background noise. Thus, the majority of users may be not satisfied with the quality of the existing speech recognition systems. There is a need for a technology or a device that can provide a good experience to users, along with reliable hands-free operation and communication. The technology should enable voice operation and communications, anywhere and anytime, and deliver clear voice and speech recognition.

Toward fulfilling the above-mentioned need, researchers from Israel-based VocalZoom Ltd. have developed a Speech Enhancement Electro Optical Microphone (SEEON).

The researchers at VocalZoom have used an acoustic sensor, optical sensor, and digital sound processor to develop SEEON. VocalZoom is providing a solution for all background noise with its unique technology that zooms in on an individual's voice while eliminating all background noise. During speech, the speaker’s facial skin vibrates at the same frequency as his or her voice. VocalZoom’s optical sensor measures facial skin vibrations created only by speech, and produces a reference audio signal that is reliable under any noise conditions. A noisy audio signal is received by acoustic microphone. The signals from the acoustic and optical microphones are fed into the noise reduction algorithm, and the end result is the noise-free audio signal.

Once SEEON is commercialized, it has opportunities to be used in headsets, wearables, smartphones, mobile computing, automobiles, and many

more applications. When VocalZoom SEEON technology was tested under babble noise, the device showed 100% word recognition rate. The results with racing car noise were the same. With the automatic speech recognition platform, under 62, 78 and 85+ dB SPL (sound pressure level), the SEEON shows a speech recognition rate of 97.5%, 96.7%, and 84.8%, respectively. The technology is highly scalable. In the future, it is expected to be used for proximity sensing, three-dimensional (3D) imaging and many more applications. VocalZoom is looking for partners to generate funding of approximately $3 million to $4 million. The company does not have any set criteria for choosing partners and is looking forward to operate under a supply and licensing business model.

In total, $18.5 million funding was generated by VocalZoom Ltd. The company initiated three rounds of funding. The funding was supported by 3M Corporation, USA; Motorola Solutions, USA; FueTrek, Japan; Mayan Ventures and Our Crowd, USA. In addition, the company has signed a strategic agreement with 3M Corporation, and joint development agreements with top 10 automotive OEMs. SEEON is expected to be commercialized by early 2016. The samples are expected to be delivered in the fourth quarter of 2015. Once commercialized, SEEON has opportunities to receive a positive response from the consumer electronics industry because of its clear speech recognition capability in noisy environment.

Details: Tal Bakish, CEO, VocalZoom Ltd., HaYetzira 6 St. Yokneam Ilit, Israel. Phone: +972-52-238-1925. Cell: +972-52-3284395. E-mail: tal@vocalzoom.com. URL: http://vocalzoom.com.

2. WIRELESS NETWORK OF ROBOTS AND SENSORS TO AID IN RESCUE OPERATIONS

Natural disasters can devastate entire districts and even larger areas, damaging buildings and infrastructure in moments and burying people alive. Finding these people in the chaos of the aftermath is not an easy task; and the speed with which rescuers can reach the victims is often the decisive factor in determining their survival. There is a need for a network of sensors or a system that can help to identify missing persons in such terrain. The system should also be easy to use, cost-effective, and provide accurate information.

To address the above-mentioned challenge, researchers from six Fraunhofer institutes have worked together on a project called Sensor Network for Katastrophen Management (SENEKA). Under the project, the researchers have developed a mobile robot sensor network for disaster management.

To make the search for buried victims more efficient and save more lives, practice tests are underway at the German Federal Agency for Technical Relief. Several Fraunhofer institutes have collaborated to investigate how robot and smart communication technologies can help in rescue efforts. In the aftermath of a catastrophe, it is critical that rescue teams obtain an overview of the situation in the affected area in order to rescue buried or injured persons in the shortest possible time. At the core of the SENEKA project is efficient networking of robots and sensors to enable them to help in these emergency operations. An appropriate number of ground and aerial robots and additional autonomous sensors are placed at strategic points in the area to be scouted. Autonomous robot vehicles, such as QuanjoTDS, distribute high-end sensor probes throughout the disaster-struck region. The probes achieve a good reception range with the support of mobile control stations. These probes also detect the potential of danger and changes in landscape. Armed with optical sensors, octocopters provide an initial overview of the area. The IOSB.AMP Q1 octocopter is equipped with a LIDAR (light detection and ranging) sensor, camera, and infrared sensors. It is employed for terrain exploration from the ground to search for missing persons. The robots and autonomous sensor probes survey the terrain and communicate with each other and with the control station. Together, they form the wireless network that covers the entire area and supplies important data that is needed to generate updated maps of the region. At the control station, the data is collected and forwarded to the rescue team with the valuable information about missing people. In this way, the mobile robot sensor network for disaster management helps to perform rescue operations.

The project was funded as part of the frontline theme of Fraunhofer, Markets beyond Tomorrow—Disaster Prediction and Management. The project was supported by Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS; Fraunhofer Institute for Integrated Circuits IIS; Fraunhofer Application Center System Technology IOSB-AST; Fraunhofer Institute for Manufacturing Engineering and Automation IPA; Fraunhofer Institute for

Physical Measurement Techniques IPM. The SENEKA project researchers are testing their product with the help of German Federal Agency for Technical Relief. The researchers are planning to display their project in the Interschutz 2015 event in Hannover, Germany. Once the SENEKA project, and the mobile robot sensor nework, is successfully commercialized, it has opportunities to get a good response across the globe in disaster situations, such as, earthquakes, tsunami, and other disasters.

Details: Christian Frey, Project Leader, SENEKA, Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB, Fraunhoferstr, 176131 Karlsruhe, Germany. Phone: +49-721-6091-332. E-mail: christian.frey@iosb.fraunhofer.de. URL: www.fraunhofer.de

3. ENERGY HARVESTER FOR POWERING SENSORS

Internet-of-Things and machine-to-machine communication are connecting devices with each other, and human interaction and activities are becoming increasingly dependent on this network of interconnected devices. These devices are either battery operated or powered with the help of cables. When cable is used to power the sensor, the range or the location of the sensor is very limited. If the sensors are battery-powered, over time, there is a need to change the batteries; and the maintenance and disposal costs can be high. There is thus a need for a technology that can enable self-powering of the sensors, overcome limitations of range, and reduce maintenance cost. In addition, the technology should be cost-effective and efficient enough to power the device for a long period of time.

Toward fulfilling the above-mentioned challenge, researchers from the Indian Institute of Science have developed a technology that can harvest energy from ambient vibrations and employ the harvester in sensing applications that require very low power.

The researchers have created an innovative energy harvester with the help of piezoelectric material. While lead zirconate titanate (PZT) has been the most common ceramic material used for piezoelectric energy harvesting, polyvinylidinefluoride (PVDF) polymer material can provide certain benefits for harvesting energy from ambient vibrations. PVDF is used because of characteristics such as low weight, flexibility, and low thermal conductivity. Stacks of PVDF are piled on each other, in the form of steps. Stacking of PVDF

on top of each other helps to generate more strain and power. This design helps to be 90% more efficient in energy harvesting than other conventional energy harvesters and will be able to power many devices and sensors at the same time. The researchers are currently working on powering fire alarms, and gas and temperature sensors, with the help of vibration energy; and are currently focusing on powering the sensors in trains and buses.

Once the harvester is commercialized, it has opportunities to be employed in low power sensing applications. The harvester can also be used to power light-emitting diodes (LEDs) and various sensors in biomedical applications. The ambient energy harvester will be used to power sensors that are employed to monitor the condition of a structure. Further, it will be used in sectors such as aerospace, transportation, and energy for powering the sensors used in structural health monitoring applications. In addition, the ambient energy harvester can be used in autonomous sensors that are employed for surveillance activities. The ambient energy harvester has a wide scope of application and will have a huge impact in future for powering sensors.

The project was funded by the Ministry of Communication and Information Technology, Government of India, under a collaborative project between the Indian Institute of Science, Bengaluru, and the Indian Institute of Technology, Bombay. The researchers are identifying various applications for the energy harvester.

Details: Rudra Pratap, Professor, Chairperson, Center for Nano Science and Engineering, Department of Mechanical Engineering, Indian Institute of Science, Bangalore 560012, Karnataka, India. Phone: +91-80- 2293-3250. E-mail: pratap@cense.iisc.ernet.in. URL: www.cense.iisc.ernet.in/rp/

4. RECENT PATENTS IN THE FIELD OF BIOACOUSTIC SENSING

Bioacoustics is a combination of biology and acoustics, which includes ultrasound and vibration. Bioacoustics technology comprises the creation, detection, and reception of sound, as well as the relation of acoustic signals to the medium through which they are dispersed. Bioacoustics sensing has been used to, for example, locate and identify animals; and is used on humans for medical applications, such as measuring body sounds on skin surface. Other medical applications where bioacoustic sensors have opportunities include regeneration of hearing and restoration of the body, reducing cancer tumors,

allergies, and body pain. In addition, it can also be employed in electronic applications.

Microsoft, in collaboration with Carnegie Mellon University, is developing a product called Skinput, based on the bioacoustics principle, which allows the skin to be used as a surface for finger input. Thalmic Labs has developed a gesture arm control band called Myo using bioacoustics. Bioacoustics can have potential over time to replace wearable user interface and electrovibration technologies . For instance, a user can play a guitar by just moving his or her hands in the air above the musical instrument. . Bioacoustics sensing is expected to converge with technologies such as augmented reality and machine learning to enable human and machine interaction.

A recent patent in bioacoustics sensing, Bioacoustic Sensor With Noise Vibration Control, (EP2846696), assigned to 3M Innovative Properties Company, pertains to a bioacoustic sensor assembly. The assembly includes a transducer that generates an acoustic signal and an actuator configured to deform a portion of the transducer to increase the signal-to-noise ratio of the acoustic signal.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
BIOACOUSTIC SENSOR WITH NOISE VIBRATION CONTROL	18.03.2015; EP2846696	3M INNOVATIVE PROPERTIES CO	ROGERS DANIEL J	A bioacoustic sensor assembly is described including a transducer generating an acoustic signal and an actuator configured to deform a portion of the transducer to increase a signal-to-noise ratio of the acoustic signal. The disclosure also provides methods and systems for reducing the impact of noise vibrations at the transducer.
ELECTRONIC STETHOSCOPE APPARATUS, AUTOMATIC DIAGNOSTIC APPARATUS AND METHOD	09.10.2014; WO/2015/010545	SAMSUNG ELECTRONICS CO., LTD.	LEE, Yoon-jae	Disclosed is an electronic stethoscope apparatus. An electronic stethoscope apparatus according to an exemplary embodiment of the present invention includes: a bioacoustics sensing part for sensing bioacoustics; a noise sensing part for sensing the noise generated in the bioacoustics sensing process; and a noise removing part for removing the sensed noised from the sensed bioacoustics and outputting the bioacoustics.
BIOACOUSTIC PROCESSING APPARATUS AND BIOACOUSTIC PROCESSING METHOD	29.01.2014; EP2689728	PANASONIC CORP	ENDO MITSURU	A bioacoustic processing apparatus capable of outputting information that represents the current state of attachment of a bioacoustic sensor. The bioacoustic processing apparatus (300), which processes acoustic signals from a bioacoustic sensor (200) attached to a body surface, comprises: a noise-extracting unit (320) for extracting the noise component contained in an acoustic signal from the acoustic signal, and a noise type classification unit (340) for classifying the extracted noise component into one of a plurality of noise types that correspond to different respective states of attachment of the bioacoustic sensor (200) and outputting information that corresponds to the results of said classification.
Weighted bioacoustic sensor and method of using same	08.12.2011; US20110301503	3M Innovative Properties Company	Carim Hatim M.	A sensor for sensing bioacoustic energy includes a housing comprising an interfacing portion configured to establish coupling with a body part during use. The sensor includes a transducer element coupled to the interfacing portion of the housing and configured to sense sounds produced by matter of biological origin. One or more conductors are coupled to the transducer element. A mass element is compliantly coupled to a surface of the transducer element. Intervening material is disposed between the transducer element surface and the mass element, and allows for differential motion between the transducer element surface and the mass element during excitation of the transducer element.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Detection of body sounds	11.12.2008; US20080306367	Koehler Ulrich	Koehler Ulrich	Disclosed is a method for detecting and monitoring body sounds in humans and animals, in which bioacoustic sensors and analyzers that are mounted downstream are used for the stationary or mobile long-term monitoring of intensive care patients' respiration, for example. The patients' lung sounds are detected and stored along with measured data which are available right away especially for the early detection of diseases and acute disturbances. Adequately monitoring intestinal sounds makes it possible to evaluate peristalsis and detect mechanical/paralytic ileus early on. An early warning system for the clinical sector immediately generates signals allowing doctors and nurses to take rapid action in case of an emergency. The inventive apparatus requires a maximum of only three bioacoustic sensors (**12**), each of which can be fixed to a point of an object body (K) facing the object, a maximum of one sensor (**14**) for recording surrounding noises, a maximum of four separable channels (**11**) for recording and transmitting sound signals or sound data detected by the sensors (**12**), and devices for supplying power and forwarding, converting, storing, and displaying sequences of signals or data on or in a recorder or a computer unit (**20**).
Cantilevered bioacoustic sensor and method using same	10.12.2008; CN101321497	3M Innovative Properties Co.	Bharti Vivek	A sensor for sensing bioacoustic energy includes a housing comprising an interfacing portion configured to establish coupling with a body part during use of the sensor. An anchoring arrangement is defined on the housing. A transducer member has an anchoring end and at least one free end. The anchoring end of the transducer is coupled to the housing such that the transducer member is arranged to be preferentially sensitive to bioacoustic energy transferred to the transducer via the interfacing portion relative to other portions of the housing.
BIOACOUSTIC ANALYSIS SYSTEM, BIOACOUSTIC SENSOR AND BIOACOUSTIC ANALYSIS PROGRAM	25.09.2008; JP2008220558	KONICA MINOLTA MEDICAL & GRAPHIC INC	WADA YASUNORI	PROBLEM TO BE SOLVED: To highly accurately analyze biological sound related to a bioacoustic analysis system, a bioacoustic sensor and a bioacoustic analysis program. SOLUTION: This bioacoustic analysis system extracts voice information part caused by a subject included in first voice information or second voice information and being attributable to a subject on the bases of the first voice information based on biological sound emitted via the biological surface of the subject and the second voice information based on biological sound emitted via the mouth or the nose of the subject, and analyzes the biological sound of the subject using the extracted voice information part as an object.

Exhibit 1 lists some of the patents related to bioacoustics sensing.

Picture Credit: Frost & Sullivan

Back to TOC