



**Featured Inventors: Mingui Sun, PhD; Wenyan Jia, PhD; Paresh Vasandani**

## The BreathEnergizer

*A self-powered wearable breathing sensor system*

### Value Proposition

Breathing is undoubtedly a key function of the human body. Breathing affects motor control, postural stability, and plays an important role in physiological and psychological regulation. Breathing changes in response to changes in emotions, such as sadness, happiness, anxiety or fear, and frequent inconsistent breathing can lead to disturbance of homeostasis, creating symptoms and compromising health.

For fitness, sports, and lifestyle consumers and for those with breathing disorders, the BreathEnergizer is a self-powered wearable breathing sensor system, intended for use in applications such as stress management, exercise training, and rehabilitation. Unlike other devices, the BreathEnergizer provides a combination of extraordinary convenience, effectiveness, and environmental friendliness.

The aim of the BreathEnergizer system is simple -- to help achieve correct and optimal breathing performance.

### Market Opportunity

Dysfunctional breathing may affect up to 1 in 10 people. However, breathing, unlike most physiological functions, can be controlled voluntarily and can thereby serve as an entry point for physiological and psychological regulation. Furthermore, audio-visual feedback with user-specific guiding waveform has been shown to significantly reduce variations in breathing.

The BreathEnergizer has two principal markets: (1) fitness, sports and lifestyle; and (2) medical. Beneficiaries in the former group range from elite sportspeople to recreationally active people to older people, while those in the latter group include people with breathlessness and exercise intolerance.

The yoga practitioners market is selected for initial market entry, as they are well aware about the importance of breathing correctly and are significantly more involved in many other forms of exercise, such as running, cycling and weightlifting, than non-practitioners. Number of US yoga practitioners has increased to 36.7M, up from 20.4M in 2012, while annual spending on yoga products rose to \$16B, up from \$10B in 2012.



Device



App

### The BreathEnergizer System

### Technology

The BreathEnergizer uses contact electrification effect to harvest energy from breathing motion, thereby working as a self-powered and dedicated breathing sensor. Worn comfortably around the abdomen just like a belt, the monitored breathing activity data is sent directly to a smartphone app that generates personalized notifications geared towards improving breathing performance. These notifications are generated by cross correlating the users breathing pattern with a selected reference breathing pattern.

### Stage of Development

Device prototyping and feasibility testing has been successfully completed.

### Competitive Landscape

The relevant devices available in the market limit at least one of the three features: mobility, accuracy, and convenience.

Respiration belt sensors require wired connections. Inspiratory muscle training products such as POWERbreathe and PowerLung are purely mechanical and need to be placed in the mouth during exercises. Spire, a clip-on device that claims to reduce stress by monitoring breathing, can monitor correctly only while sitting.

There are no dedicated breathing sensors available that are self-powered, wearable, and wireless.

### IP Landscape

The Technology Transfer Committee (TTC) has approved the filing of a provisional patent application before 10/19/2016. No prior-art found for a self-powered wearable breathing sensor or a wearable respiratory energy harvester.

# FEATURED INVENTORS:

## *Wenyan Jia, PhD*

Dr. Jia's research interests include biomedical signal and image processing, wearable electronic device, and mobile health. She has more than 100 publications.

### **Education**

- BS, Biomedical Engineering, Capital University of Medical Sciences, 1998
- MS, Biomedical Engineering, Capital University of Medical Sciences, 2001
- PhD, Biomedical Engineering, Tsinghua University, 2005

## *Paresh Vasandani*

The BreathEnergizer is a result of Paresh's PhD research work which deals with harvesting energy from breathing motion. Paresh has over 5 years of medical product development experience in start-ups, working on a range of products, performing diverse tasks from concept through testing, and validation. He has successfully contributed in taking two products from concept to launch.

### **Education**

- BE, Biomedical, Mumbai University, India, 2007
- Master of Product Development, Carnegie Mellon University, 2010
- PhD Candidate, Bioengineering, University of Pittsburgh, present

## *Mingui Sun, PhD*

Dr. Sun's research interests include neurophysiological signals and systems, biosensor designs, brain-computer interface, bioelectronics and bioinformatics. He has more than 400 publications.

### **Education**

- BS, Instrumentation/Industrial Automation, Shenyang Chemical Institute, 1982
- MS, Electrical Engineering, University of Pittsburgh, 1986
- PhD, Electrical Engineering, University of Pittsburgh, 1989

### **Publications**

1. Vasandani P, Mao Z, Jia W, Sun M. Design of simulation experiments to predict triboelectric generator output using structural parameters. *Simulation Modelling Practice and Theory*. 2016;68:95-107.
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6. Justin G, Zhang Y, Cui X, Bradberry C, Sun M, Sclabassi R. A Metabolic Biofuel Cell: Conversion of Human Leukocyte Metabolic Activity to Electrical Currents. *J Biol Eng*. 2011;5(1):5.
7. Zhang K, Zhang H, Yao N, Sclabassi RJ, Sun M. Carried Load Measurement Based on Gait Analysis and Human Kinetics. *In Image and Signal Processing, 2008. CISP'08. Congress on 2008 May 27 (Vol. 3, pp. 104-107)*. IEEE.
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