

## At-a-glance

SmartSen has developed a Smart Sensor, comprised of various sensing technologies, to assist doctors in accurately diagnosing medical conditions.

A Medical device - for healthy Life at home - of vital signs diagnosis by using Artificial Intelligence (AI).

The first version **StethOptic**, a Contactless Optical Stethoscope, adjusts to the desired body checkpoints according to the specification of the examining remote medical professional, in order to sense vital signs and weak signals. Laser sensor integrated with MilliMeter-Wave Radar sensor and AI.

## The Challenges

The challenges (**Needs nowadays**) for an innovative product as SmartSen - for healthy Life at home:

- Detects and diagnoses body's vital signs through remote sensors and without touch as possible
- Detects and diagnoses malfunction and unwanted motility of body's organs
- Enables remote use of home medical sensors for primary care and emergency medicine
- Provides continuous monitoring and diagnosis in real-time, without any interruptions even during sleep
- Provides an option for self-examination and sending the resulting recording to a doctor
- Enables diagnosis by measuring the temperature change of specific organs and various body parts
- Enables diagnosis as a result of change in color, texture, and undesired motility in sensitive organs
- Can assist in preventing the spread of infections - especially in cases such as Covid-19 diseases

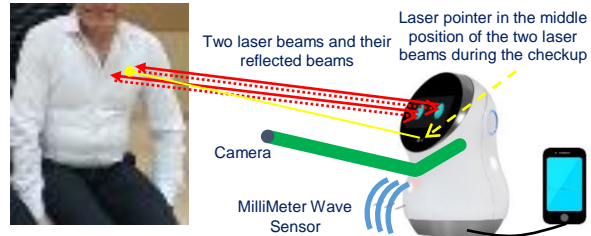
## The first Product - StethOptic

- Provides sharp listening, while getting an initial diagnosis and viewing the examined signal
- Detects and diagnoses, without touch, through remote sensors body's vital signs, sounds, infrasound, noises, tiny vibrations, rustles, and vibrations. From the throat, back, abdomen, lungs, chest, heart, and other organs
- Detects and diagnoses changes and unwanted motility of body's organs, dysfunction & narrowing of internal organs
- It is used simultaneously with one or two laser sensors, millimeter-wave radar, temperature monitor and a camera
- Performs a correlation between all received signals to improve the diagnostic abilities and results
- Can aide in establishing an initial diagnosis via deep learning and artificial intelligence tools to perform appropriate labeling and classification of new recordings
- A unique diagnostic tool which based on - the classification through Artificial Intelligence, the form of each anomaly/exception, and medical statistics
- The device at home and the physician smartphone behaves as an IoT with the cloud computing connectivity and with all needed compliance of FDA regulation (as HIPPA)



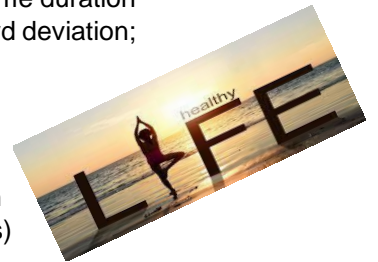


**SmartSen**  
Healthy Life @home



## StethOptic is comprised of:

- (1) Unique "Synthesizer" of the body's auscultation (filtering/amplifying to any desired sound) using the technology of Digital Signal Processing with dedicated filters by algorithms;
- (2) An alert for any exceptions and anomalies as defined about (a) signal amplitude, time duration and different frequency or sound, (b) medical statistical measurements and standard deviation;
- (3) A monitor of the physiological movement of all organs specifically detecting undesired changes in organ movements inside the body;
- (4) Dedicated algorithms and signal processing that allows the extraction and the separation of remote sound sources and weak signals;
- (5) A growing database of many diagnoses, as a result of labeling and classification process by the deep learning and Artificial Intelligence tools (most of the R&D efforts)



## Signals for Processing-Technical Clarifications

- Auscultation of sound sources of any internal body's organ from which acoustic sounds and noises can be absorbed
- Mobility and sounds inside the body propagate all over the skin and these tiny vibrations are measured by detecting the laser's reflection on the skin through the laser/photodiode. The laser sensor provides fast processing and calibration on velocity and distance measurements of body's fluctuations
- The technology of remote photonic bio-sensing module has the ability to use dynamic extraction of remote weak sounds while it filters them amongst other signals and noises
- In some cases, we can use two optical laser sensors together in order to improve the listening quality and diagnosis of very weak signals and to make a focused diagnosis in order to calculate the internal distance of the sound source (using dedicated autocorrelation algorithm by comparing data and phase differences between the two sensors)
- Utilizing AI (Artificial Intelligence) will improve accuracy in diagnosis. In a low-signal-to-noise ratio, we can use also Bit Error Rate calculations that the computing system has to correct

## The "Check-up" Capabilities of StethOptic

- The product allows simultaneous checking of a variety of biomedical signals such as heart-breathing sounds and various gastroenterology diseases. It accurately distinguishes between very weak signals. These signals are analyzed and an assessment is made of the abnormal behavior of organs in the body
- The product allows remote physicians to perform visual examinations to detect specific signals on the patient's body. The product is convenient and easy to use without the need for body contact, usually without the need to undress, and without the need to disinfect or clean the device.
- Doctors can use the diagnosis and analysis tools while hearing and graphically viewing simultaneously the desired signal that appears in the timeline and the frequency axis

# StethOptic's Advantages

The s StethOptic's Advantages will be sent per request.

## Additional Innovations (in next version):

The additional Innovations (in next version) will be sent per request.

## The StethOptic Team

- Shai Richter (B.Sc.EE, MBA) – Entrepreneur, system engineering and product management. Experience in the development of multidisciplinary products with hardware, embedded software including IoT with cloud computing, leading R&D, engineering and marketing
- Dr. ET (PhD) – image processing and algorithm development, a specialist in the integrated fields of physics and biotechnology (Hebrew University). Experience in image processing and development of machine learning algorithms, deep learning in Matlab tools and Python software and in the integration of various computing cards
- Dr. YR (PhD) – an expert in signal processing and algorithm development using Matlab for RF and mmWave signals, in very weak signals such as radar signals
- Dr. AB (PhD) – Specialist in electro-optics and algorithmic, Machine Learning, Deep Learning, Computer Vision. Consulting and guidance for the development of algorithms and integration with the optical sensor. Expert in the fields of electro-optics, RF-photonics, biomedical optics, physical simulations of sensors, laser elements design in a remote electro-optical estimate of sound sources and medical parameters (in aspects of mathematics, physics and engineering)
- SR (M.Sc.EE) – Specialist in digital and analog hardware development with microcontrollers, ASIC / FPGA, embedded software and drivers. Integration with various sensors, cameras, electro-mechanics elements, wireless, serial communication components, and protocols
- YR (M.Sc.EE) – Specialist in software development integrated with rules system and Artificial Intelligence, by using development methodologies and quality assurance. Developing engine of expert systems and business rules for large organizations, industry and the health insurance fund
- Dr. SG (M.D.) – Physician specializing in pediatrics and emergency medicine at the Maccabi Health Insurance Fund and Tel Hashomer Medical Center
- RS (MA, Marketing) - Product management and marketing promotion. Experience in product positioning, focus on potential customers and market segments versus advantages and disadvantages in competitors, promotion for exhibitions. Good knowledge of the American market

## The Marketplace

### Target marketplace of the product

- Primary medicine - family doctors, pediatricians, primary physicians and nurses,
- Home care – elderly, infants, children
- People suffering from health risks - chronic patients, patients after surgery at home, follow-up at staying home

**Collaborations with:** Health care providers, virtual hospital (home hospitalization department), organizations and health funds, independent physicians, health insurance companies, rehabilitation and geriatric centers, institutions and organizations for the elderly and disabled.