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Exclusive
Calcalist

The camera that measures blood pressure from a distance of 400 meters

The camera is aimed at a person and can decipher whether they suffer from heart disease. ContinUse Biometrics is currently attempting to develop what sounds like science fiction. Is it on the verge of a medical breakthrough? Its investors, Lenovo, Tyco and Olive Tree, think so.

Omer Kabir 05.04.17

Professor Zeev Zalevsky, CTO at the hi-tech company ContinUse Biometrics – CU has a camera. He can aim it at you, and use it to read precise data about your physical condition, such as your respiratory rate, heartbeat, blood pressure, and even the level of blood alcohol and glucose. It's immaterial whether he is standing 4 or 400 meters away. Sounds like sci-fi? Even Zalevsky admits it. However, this novel technology is not only real, but is expected to be available for widespread consumer use later this year, by means of a small camera which can work with any smartphone or computer.

Now, ahead of launching the sensory camera, CU is revealing the details for the first time. "This technology will allow us to establish an organization which will make a difference in the world, which will change the rules of the game," Asher Polani, the company's CEO told Calcalist. "If my platform will be special and inexpensive enough – it can enter into all avenues of life."

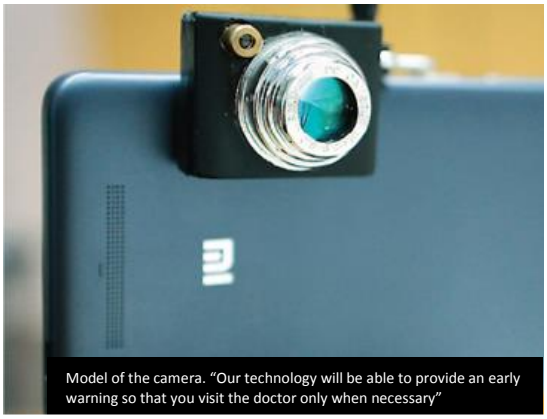
The head is a guitar

At times, the technology certainly does not sound realistic. How can a camera know my blood alcohol levels? For many, this promise will evoke an association with the 2009 "wonder patch" incident, where the duo of Arik Klein and Dr. Amos Buchnik claimed to have discovered a patch that could predict heart attacks – and were later convicted of fraud.

While skepticism is understandable, here the technology is backed by well-known, experienced investigators: Prof. Zalevsky from Bar-Ilan University's Faculty of Engineering, and Prof. Javier Garcia from Valencia University in Spain, both of whose research work served as a basis for the activities of companies such as PrimeSense. The technology is also backed by a long line of registered patents and academic articles.

Furthermore, CU is not a two-employee company, but rather has 40 employees, most of whom have a doctorate or engineering degree, and in which technology companies and venture capital funds such as Lenovo, Olive Tree Ventures and Tyco have already invested. (The company did not convey how much had been raised to date). It also has the support of the Israel Export Institute.

This is the way the sensor works



Model of the camera. "Our technology will be able to provide an early warning so that you visit the doctor only when necessary"

1. **Emission**: the camera emits a laser beam towards the person whose data are to be measured
2. **Fluctuation**: The beam exhibits the physical phenomenon of "interference," the laser light being made up of tiny spots of light and dark, whose arrangement is affected by the structure of the body it strikes and by the fluctuations in it
3. **Variability**: the camera is equipped with a special lens, which causes the spots to vary according to a specific pattern, based on the fluctuations
4. **Decoding**: an advanced system of analysis decodes the change in the spots and from it is able to generate information about the human body towards which the beam was emitted
5. **Production**: the first commercial product will produce information of physiological parameters such as heart beat, breathing rate, blood pressure and blood glucose levels

Picture: Tal Azulai

Zalevsky got the idea to develop the technology while watching the movie "From Russia with Love," from the James Bond series: "In the movie, they shone a light on a window, and tried to hear what was happening in the room in which people sat talking," Zalevsky describes. "Technology which allows one to hear by means of light is very exotic – and it's also realistic: there is a laser which lights the window, the light comes back and is received by a device called an interferometer, which is able to identify the optical wavefront. Based on the wavefront, the vibration of the window can be identified, which is affected by the words being spoken in the room, since these are sound waves which disperse and strike the window. The technology was very popular in the 70s. There were employee reports of headaches in various US embassies in East Europe at the time, and it was later ascertained that the KGB transmitted all sorts of things at the windows. That technology had some drawbacks: it is not portable, the device must be at window-height, and if there is noise in the room, or more than one speaker, signal saturation occurs and it is impossible to hear anything; and the biggest disadvantage is that you need a window. Without a window, nothing is audible."

Zalevsky relates that he tried to figure out if it would be possible to create an effect to overcome these drawbacks. "The initial motivation was to hear. The head is like a sound box which vibrates when we speak, very much like a guitar. The idea was to shine the laser on the head and to record the vibrations, unrelated to the question of whether there was surrounding noise or where the sensor was in relation to the head: to utilize the self-interference effect of the light."

Constructive and Destructive Interference

CU's camera is based on known principles of physics, and the explanation starts with the laser beams which lights up the wall. "The light produced by the laser is not uniform, but rather is made up of tiny spots of light and dark," Zalevsky explains. "Why does this happen? Lasers have a property known as 'coherence of light.' It creates a situation where the photons, the light particles, are connected to each other.

When I have a rough surface, the photons are reflected from different angles and collide with each other. Since they are connected to each other, they can create 'constructive interference' where the photons reinforce each other or 'destruction interference' where the photons cancel each other. When I see a small light spot, this is when a photon connects to a photon. When I see a small dark spot, this is when a photon is diminished by a photon: it is weakened.

ContinUse Biometrics

Area of activity: identification of non-contact physiological parameters

Location: Tel Aviv

Year of founding: 2015

Senior staff: Asher Polani (CEO), Prof. Zeev Zalevsky (CTO), Prof. Javier Garcia (Chief Scientist), Dr. Yevgeny Beiderman (CRO), Amit Klir (Head of Engineering)

Employees: 40

Investors: Lenovo, Olive Tree Ventures and Tyco

"If the surface moves, these spots change in a random fashion. We created optics – a special filter that causes the spots to change according to a pattern, based on movement on the surface that dispersed the light. Our system analyses the change in the spots, compares it to the guidelines of how this change ought to be, and from there, with high accuracy, it can analyze the change and draw conclusions from it; the analysis – this is the second part of our technology."

Accuracy does not depend on the range

A few years passed from its conception to the point where Zalevsky and Garcia had a product in hand that they could test. "Right from the initial trial, we saw that it works, and we started to quantify," Zalevsky relates. "We noticed that the sensitivity to movement and to vibration was extremely high, and we decided to attempt to measure it using medical parameters: everything in life is a vibration: blood pressure, heartbeats. The question is whether the device you have is sensitive enough to measure it."

Zalevsky said that in the beginning they tested parameters that were relatively easy to measure: "We began with simple things, such as measuring breath, which has considerable mobility. The accuracy was high, and we decided to progress to something more sensitive and more difficult to measure, which has a lower mobility, such as heartbeats. I am not only referring to the number of heartbeats, but also to the type of beat, which in medical terms is known as a 'phonocardiogram,' the unique sounds produced by the heart when it expands and contracts.

The fact that I have heart rate of 60 beats per minute may be fine, but the heart could still be diseased. The phonocardiogram enables quite an extensive medical picture."

The developers saw that the tool they had was still extremely sensitive "So we said, let's go a step further, and we measured blood pressure using the camera. And then we said, let's measure hematology, blood chemicals, where very high sensitivity is required. Chemical changes have an indirect effect on the mobility of the tissue adjacent to the blood. For instance, there is a chemical that changes the viscosity of the blood. Some chemicals even affect the phonocardiogram. For example, if I drink alcohol, there is a change in the way the heart beats."

Zalevsky himself admits that the device he created is "partly science fiction. The technology can also take all these measurements at a very long range. The accuracy almost does not depend on the range; we took measurements from nearly 400 meters away. Everything depends on the power of the lens and the power of the laser – using the camera I can look at a person 400 meters away and know which chemicals he has in his blood, what his blood pressure is, and how well his heart is functioning."

Asher Polani with models of the camera. "Our technology will be able to provide an early warning so that you visit the doctor only when necessary" Picture: Orel Cohen

Bring medicine into your home

The transition from the academic world to the business world took place three years ago, at a coincidental meeting between Zalevsky and Polani. "He told me about the technology that he'd been developing since 2006," said CEO Asher Polani. "This was technology in search of an application, developed for academic needs, but it piqued my interest to get involved, and we decided to start in the area of human identification based on heart sounds which are unique to each and every person. We raised funds based on this, and we launched the company."

But matters changed very quickly when the first external investors entered the company: Lenovo and Olive Tree. "They realized the technology goes beyond biometric identification, and said that it would be a waste to harness the technology for the benefit of only one application, and that they were willing to develop a platform which will serve as the basis for many applications. They told us to do research and to build a platform which we will use in the future."

This took place two years ago. Today, the company has abilities in six fields: identification of physiological parameters such as heartbeat, breath, blood pressure, blood oxygen saturation; identification of parameters such as blood alcohol, glucose and blood viscosity; people identification based on the sound of their heart; applications related to the musculoskeletal system: muscle tone, fine fractures, and even parameters regarding the development of neurological diseases such as Parkinson's or ALS; tomography which will allow radiation-free scanning and will allow the abilities of a CT scan to be brought into the operating room; and "sound parameters," a field mainly used by industry which will enable the identification of cracks in pipes or industrial products, regarding which the only current way of identifying faults is by using x-ray.

"We decided to concentrate on the health sector, 75% of the efforts are directed there," says Polani. "In the health field, we are touching on a central theme – the person at home who wants to receive better medical treatment, starting from minimal treatment in developing countries to preventive medicine which enables life extension or improved life quality for those which cardiac disease or respiratory disease in developed countries: everyone has an interest in advancing these issues. The governments of developing countries want to bring relief to the villages and the weaker strata. In developed countries, they want to practice as much medicine as possible in the community, in

order to minimize hospital visits. We would like to extend this arm to within the home. We are not competing with existing devices, although we will get to that later on. We want an inexpensive device to treat people at home."

Zalevsky added: "There is a trend to budget medical treatment costs due to the population expansion. Therefore, the world is moving in the direction of early screening. Our technology will be able to provide an early warning so that you visit the doctor only when necessary."

Profile of vibrations

Despite all the optimism expressed by Polani and Zalevsky, this technology has quite a few aspects which threaten to infringe on personal privacy. "I once used to call this 'big brother' but I stopped," Polani says. "We are not photographing people. Can someone use this in a disreputable way? Every sensor around you can collect information. Our sensor captures the body's fine movements, and if someone infiltrates the system, it can be abused. But to do so, the translation tables would be needed: the algorithm for decoding the raw material. If you penetrate my system, you will get a picture of the vibrations. Our algorithms are required. The raw material gives nothing away."

Zalevsky adds that "technology is neither good nor bad. Everything can be very dangerous in the wrong hands, and very useful in the right hands: when you make a biometric passport, you can ask the same question. Actually, in our case, as opposed to the biometric database, if information leaks out, it will be much more limited: with us, a profile of vibrations is received. A person who sees you on the street does not know that the information is connected to you. The breach of privacy is much smaller than with conventional biometric information. It's a lot less visual that the things being used on a daily basis. It's not like a fingerprint. It cannot identify one person out of millions, but one out of a hundred at most."

Zalevsky considers there is more to his work than the creation of a technological and business platform. "It's a sort of modern Zionism," he says. "To come to the world, and to create a healing connotation, that you will be healed thanks to Israeli technology; in my book, that's extremely important. It is a kind of public diplomacy. You can't compete with propaganda showing pictures of injured children and destroyed homes. You can't respond, even if you are right, there is nothing to say – but when you come and state that the health of the people of the world is of prime importance to our country, that is an assertion and declaration that has significance which goes beyond politics. That is a mission."

This article was published in Hebrew on April 5th, 2017. It can be found here.