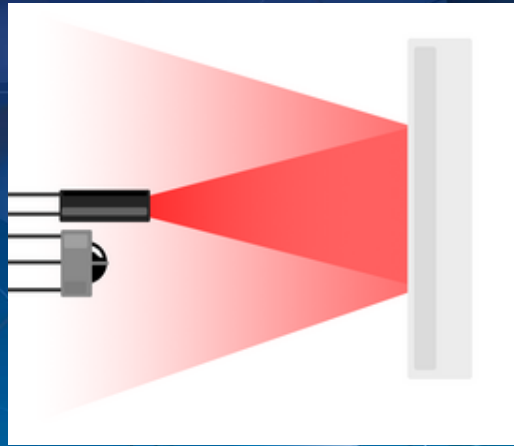


Sensor Technology (TechVision)

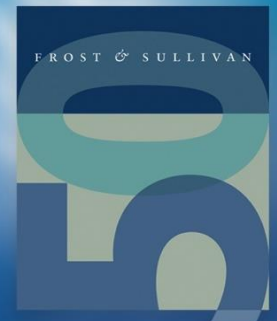


Infrared Sensing

Infrared sensors poised to impact consumer electronics

D727-TV

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Innovations in Infrared Sensing

Advancement in Alzheimer's Detection

Ruhr-Universität Bochum, German Center for Neurodegenerative Diseases–Peter

IR Sensor-based Blood Test May Facilitate Early Detection of Alzheimer's Disease

Researchers at Ruhr-Universität Bochum, German Center for Neurodegenerative Diseases have developed a blood test based on immunological chemical analysis using an infrared (IR) sensor that has potential to facilitate early detection of Alzheimer's Disease (AD). The IR sensor determines whether the biomarkers (secondary structure of the amyloid beta peptides) indicate pathological changes, which can occur more than 15 years before the appearance of clinical symptoms. The sensor surface is coated with specific antibodies that extract biomarkers for AD from blood or the cerebrospinal fluid, taken from the lower back.

Competing Aspects

- The IR sensor, which extracts the amyloid peptide from body fluids, is able to detect the misfolding of amyloid beta peptides. The misfolded structure results in plaque deposits typical of AD.
- Positron emission tomography (PET) is expensive to detect amyloid plaques and involves radiation. Enzyme-linked immunosorbent assays (ELISA) tests for amyloid beta peptide have not provided information about the distribution of the secondary structures at once.

Technology Readiness Level:4

The researchers analyzed samples from 141 patients; and achieved diagnostic precision of 84% in the blood and 90% in cerebrospinal fluid compared to the clinical gold standard.

Attributes of Innovation

There is a key need for a blood test that can detect AD at a pre-dementia stage so that a drug could be applied in time to prevent or inhibit the onset of the disease. The IR sensor is able to detect in a label-free fashion how all existing amyloid beta secondary structures are distributed.

Market Readiness & Commercialization Strategy

The results of testing for early detection of Morbus AD on a small group of patients suggested that increased concentration of misfolded amyloid beta peptides can be detected in body fluids even in the pre-dementia stages. Analysis for early detection in 800 study participants is underway to optimize statistical significance.

Impact & Opportunities

Commercialization/Widescale Adoption

The technology would have commercialization potential once it demonstrates successful results on a wider group of sample participants.

Impact on Industries/Specific Apps.

Detection, amelioration, or prevention of Alzheimer's

Market Potential/Opportunity

Key opportunities exist for the technology that would allow for reliable early detection of AD that has accounted for the bulk of the cases of dementia.

Technology Convergence

- Advanced health monitoring
- Advanced drug treatment for diseases

Enhancements in Indoor Air Quality Detection

VTT Technical Research Centre of Finland Ltd.

IAQ Monitor Detects CO₂, Temperature, Humidity and a light Indicator for CO₂ Levels

The researchers have developed an indoor air quality monitoring device that detects carbon dioxide, temperature, and humidity and has LED (light-emitting diode) light signals to guide individuals toward a healthy environment.

Competing Aspects

The indoor air quality monitor combines a non-dispersive infrared (NDIR) sensor to detect carbon dioxide, LEDs, and wireless communication. The device's hybrid integration technology allows for it to be cost-effectively manufactured on an industrial scale. A tiny node platform allows for monitoring indoor air quality remotely and for communication with other IoT devices.

Technology Readiness Level:5-6

Technology is validated and demonstrated in the relevant environment.

Attributes of Innovation

A key distinguishing feature is the light indicator for CO₂ levels that effectively and conveniently guides people to a healthy area. LEDs of different colors indicate when the CO₂ level exceeds a certain threshold. As the level of gas increases, the light changes from green to amber to red. The device can be easily configured to monitor VOCs (volatile organic compounds).

Market Readiness & Commercialization Strategy

VTT is providing the technology underlying the device to another entity that is willing to commercialize the technology.

Commercialization/Widescale Adoption Year

The technology is expected to have opportunities for commercialization over the relative near-term.

Impact on Industries/Specific Apps

The solution has been designed to monitor indoor air quality in public environments such as offices, classrooms, movie theaters.

Market Potential/Opportunity

Key opportunities exist for this technology, which can enhance indoor air quality monitoring through its ability to guide people to a safer environment, and its wireless data transmission capacity, which can allow access to the device's data via a mobile phone and transmission of data to cloud services.

Technology Convergence

- Wireless communications
- Smart cities
- NDIR gas sensors

Impact & Opportunities

Infrared Depth Sensing System

Massachusetts Institute of Technology (MIT)

Phone-based Laser Rangefinder Developed

Tech. Profile

Researchers from MIT have developed an infrared depth sensor with the help of extremely high energy short burst of light. The system captures the videos in four frames. Two of them capture the ambient infrared light and the other captures the reflection from the laser's signal.

Competing Aspects

- ✓ Reliable/accurate
- ✓ Robust
- ✓ Longer lifetime
- ✓ Easy to integrate

Innovation Attributes

The laser in the sensing system emits light in a single plane and employs a technique called as active triangulation. The system gauges depth to an accuracy at range of 3 to 4 meters in such a way that when the sensing system captures four frames of information, two frames of ambient light information are deducted from the total information captured.

Wide-scale Adoption

The built-in infrared laser will enable various types of devices with intelligence. The device can be integrated into personal vehicles such as wheelchairs or golf carts. In addition, it can also be expected to be employed in autonomous robots such as drones. The infrared depth sensing system is expected to be commercialized in the next two to three years.

Market Opportunity

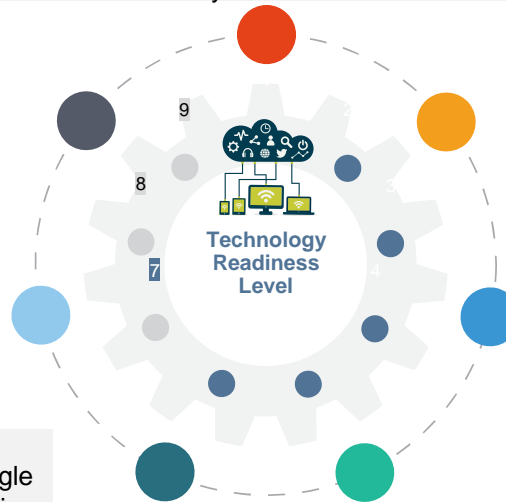
Future smartphone cameras with a global shutter (which reads measurements from all the photodetectors simultaneously) will help to enhance the accuracy range of the device. In addition they will also help speed the development of full autonomous vehicles.

Technology Convergence

- IoT
- Predictive analytics
- **Autonomous vehicles**

Market Entry Strategies

MIT will support the Singapore Ministry of Transport to enable a seamless driving experience. The device will be placed inside future smartphones. MIT is also expected to license the technology to some of the major smartphone OEMs.



Near Infrared Spectrometer

Consumer Physics, Israel,

Miniature, Rapid Near Infrared Spectrometer

Technology Profile

Consumer Physics have raised \$11.47 million of funding from three different rounds of investment. The funding was raised to mass produce its device called SCiO (Spectroscope). The company is currently focusing on the different stages of the food ecosystem.

Who

Where

Consumer Physics Inc., founded in 2011 and based in Israel

The company has created a highly innovative SCiO device, which leverages low-cost optics and advanced signal processing algorithms, to provide a miniature, consumer friendly near infrared (NIR) spectrometer that can be mass-produced at low cost. The company uses technologies developed for cell phone cameras and optical communications devices to significantly reduce the cost and size of NIR spectrometry systems

What

Competitive Aspects

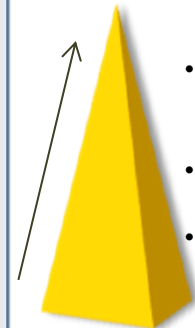
- Easy to use
- Longer Lifetime
- Cost Efficient

Working Principle

- ✓ **SCiO** contains a light source that illuminates the sample and an optical sensor, or an infrared spectrometer, that collects the light reflected from the sample. The spectrometer breaks down the light into its spectrum, which includes the information required to detect the result of the interaction between the illuminated light and the molecules in the sample. To provide real-time information to the consumer, SCiO can communicate the spectrum of the sample.
- ✓ Spectrum can be analyzed within milliseconds with the help of advanced algorithm and it can also swiftly deliver information about the analyzed sample back to the user's smart phone.
- ✓ SCiO has been aimed at applications, such as food, pharmaceuticals, and horticulture.

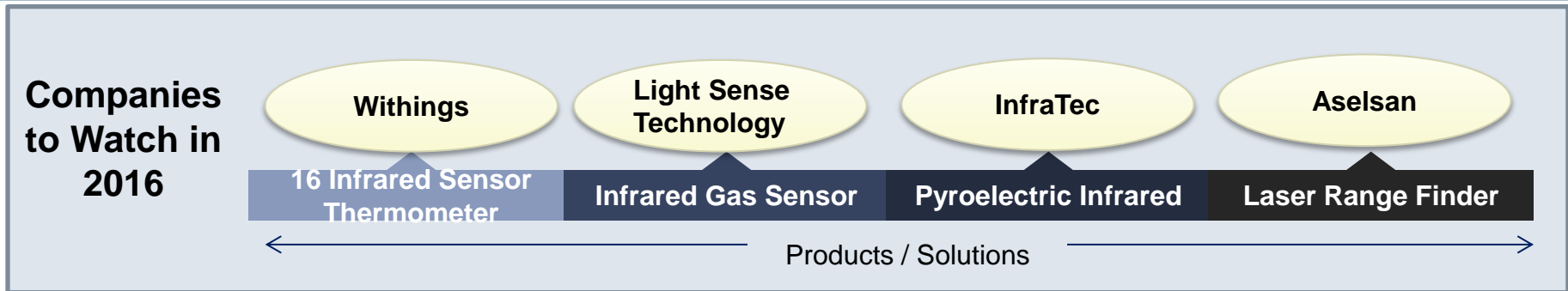
Innovation Attributes

- The basis for the NIR spectroscopic material analysis method used in SCiO is that each type of molecule vibrates in a unique way, and such vibrations interact with light to create a unique optical signature.
- SCiO can isolate the concentration of macronutrients and measuring hydration levels in plants.
- To deliver relevant information in real time, SCiO can wirelessly communicate the spectrum of the sample to a smart phone, which can send such information to a cloud-based service for review.

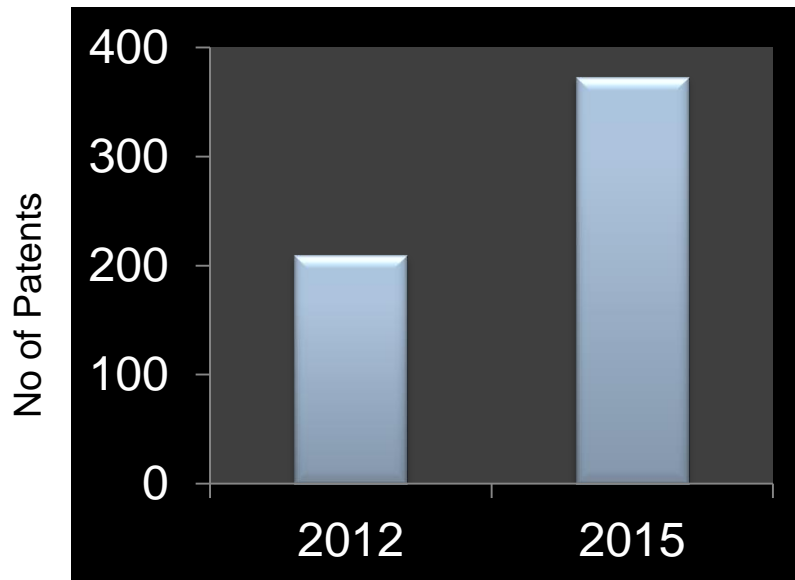


Strategic Insights

Strategic Insights



Intellectual Property (IP)



Source: WIPO/Frost & Sullivan

- With the help of patent filing trends it can be said that the consumer electronics industry will be hugely impacted by infrared technologies. The major products in which infrared technology will be deployed are smartphones, tablets, personal computers, laptops, and television sets. It will then have opportunities to percolate to a plethora of electronic devices or systems, including toys, automotive, home automation, healthcare, virtual gaming, and robotics, which will witness the impact of infrared technologies.
- There is a concerted effort to further develop infrared technology in the North American region. In Europe, different countries, such as Belgium and Germany, are actively developing infrared techniques.

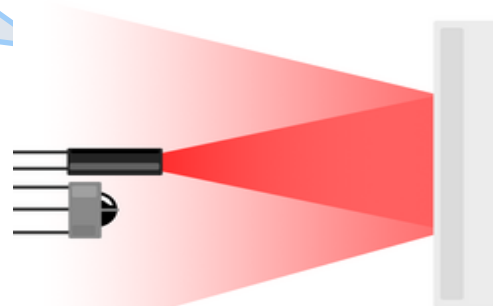
Strategic Insights (continued)

Key R&D Focus Areas:

- Improving Détection range and ability to work under different lighting conditions
- Laser-based mapping
- Infrared depth sensing and MASINT(Measurement and Signature Intelligence)

Growth Factors:

- Design flexibility
- New product development
- Strong R&D efforts
- Technology advancements
- Greater demand for enhanced user experience
- High application scope
- Better visualization



Adoption Barriers

- System reliability
- Cost
- In depth sensing, technological challenges in capturing and processing of data under different lighting conditions can pose challenges in the short term. However, technological advancements are expected to reduce the impact in the long term.

Focus on Consumer Applications:

Venture funding has indicated a positive outlook toward consumer electronics applications of infrared sensing technology.

The 2020 Scenario

- Aerospace and defense industries will witness an increase in adoption of infrared systems.
- Raytheon, Lockheed Martin, FLIR Systems, and DRS Technologies are among those who look to develop enhanced products based on infrared sensing with improved capabilities such as range and efficiency.
- Reduction in the price of cooled infrared sensor, possibly through enhancements in less expensive cooling techniques can bolster the proliferation of infrared systems, while enhancements in resolution and sensitivity can boost opportunities for uncooled microbolometers .

Key Patents

Key Patents

No.	Patent No.	Publication Date	Title	Assignee
1	US20160081552	24.03.2016	Enhanced visible near-infrared photodiode and non-invasive physiological sensor	Masimo Semiconductor Inc.
	<p>Embodiments of the present disclosure include a photodiode that can detect optical radiation at a broad range of wavelengths. The photodiode can be used as a detector of a non-invasive sensor, which can be used for measuring physiological parameters of a monitored patient. The photodiode can be part of an integrated semiconductor structure that generates a detector signal responsive to optical radiation at both visible and infrared wavelengths incident on the photodiode. The photodiode can include a layer that forms part of an external surface of the photodiode, which is disposed to receive the optical radiation incident on the photodiode and pass the optical radiation to one or more other layers of the photodiode.</p>			
2	US20160088371	24.03.2016	Infrared proximity sensor control of devices	Itron Inc.
	<p>Infrared proximity sensor control of devices is described herein. One disclosed example apparatus includes an infrared proximity detection sensor disposed within a substantially environmentally-isolated zone of an electronic device, where the infrared proximity detection sensor is to detect an input sequence, and a processor to receive the input sequence, where the processor is programmed to interpret a command by comparing a defined sequence to the input sequence.</p>			

Key Patents (continued)

No.	Patent No.	Publication Date	Title	Assignee
3	US20160086999	24.03.2016	High near infrared sensitivity image sensor	Omnivision Technologies Inc.
	<p>An image sensor includes a plurality of photodiodes disposed proximate to a frontside of a first semiconductor layer to accumulate image charge in response to light directed into the frontside of the first semiconductor layer. A plurality of pinning wells is disposed in the first semiconductor layer. The pinning wells separate individual photodiodes included in the plurality of photodiodes. A plurality of dielectric layers is disposed proximate to a backside of the first semiconductor layer. The dielectric layers are tuned such that light having a wavelength substantially equal to a first wavelength included in the light directed into the frontside of the first semiconductor layer is reflected from the dielectric layers back to a respective one of the plurality of photodiodes disposed proximate to the frontside of the first semiconductor layer.</p>			
4	US20160087000	24.03.2016	Infrared image sensor	Sumitomo Electric Industries Ltd.
	<p>An infrared image sensor includes a bias circuit receiving a timing signal, the bias circuit generating a bias voltage having a first value and a second value in response to the timing signal; a semiconductor light-receiving device including a photodiode, the semiconductor light-receiving device receiving the bias voltage; a read-out circuit including a read-out electrode connected to the photodiode, the read-out electrode receiving electrical signal from the photodiode; and a signal processing circuit processing a read-out signal from the read-out circuit synchronously with the timing signal. The photodiode includes an optical absorption layer made of a III-V group compound semiconductor. The optical absorption layer has a type II multi quantum well structure including first compound semiconductor layers containing antimony as a constituent element and second compound semiconductor layers that are stacked alternately.</p>			

Key Patents (continued)

No.	Patent No.	Publication Date	Title	Assignee
5	US20160088240	24.03.2016	Protective window for an infrared sensor array	FLIR Systems Inc.
	Various embodiments of the present disclosure may include a focal plane array configured to capture thermal image data from a scene. The embodiments may further include a sensor window displaced a first distance from the focal plane array. The embodiments may also include a protective window displaced a second distance greater than the first distance from the focal plane array, wherein the second distance causes damage or debris incident on the protective window to be out of focus in the thermal image data.			

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Industry Contacts

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