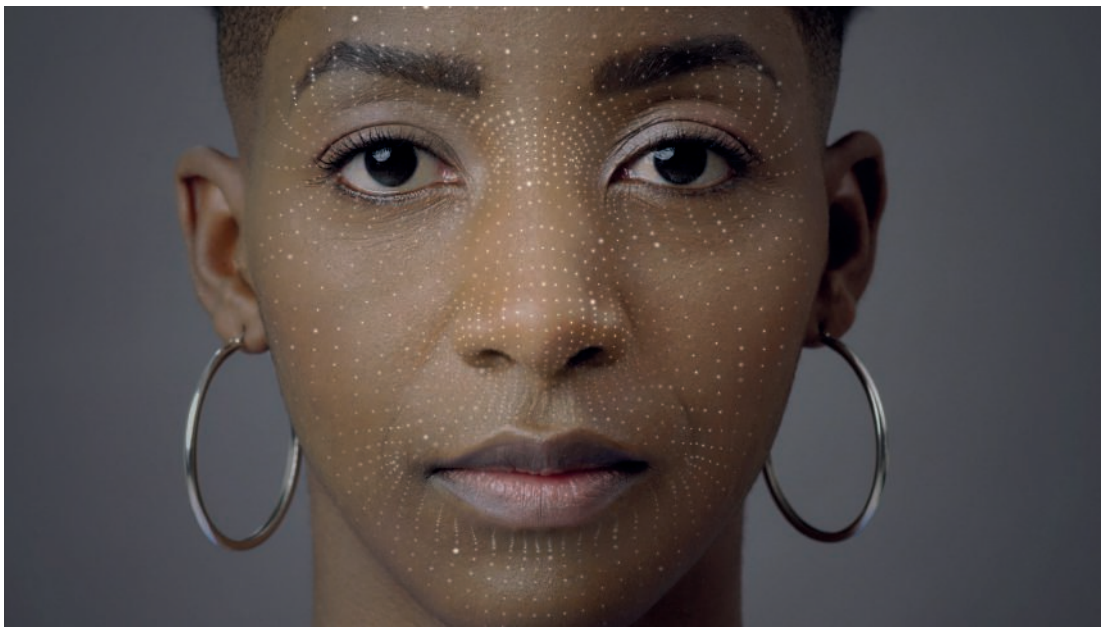

Mobile 3D sensing

VCSEL technology encourages progress in biometric solutions such as mobile 3D sensing, according to **Bianka Schnabel**

Many of the key technologies behind advancements in mobile devices, including smartphones, tablets and wearables, are based on the ubiquitous use of light. This does not only include visible light such as display lighting or flash applications.

Gesture recognition, iris scanning or facial recognition are just a few examples of how invisible infrared light can be used in mobile devices. What role can VCSEL technology (vertical-cavity surface-emitting laser) play in this space?

First, what is VCSEL? A VCSEL is a semiconductor-based laser diode which radiates the light vertically to the surface of the semiconductor chip, as opposed to edge-emitting laser diodes, where the light exits at the edge of the chip. As a surface mountable component, VCSEL combines the characteristics of a LED with those of a laser. VCSEL technology has been established and matured within the datacom industry, serving in data infrastructure links for more than 15 years.

The technology can also be used as an array – a composite of several hundred or even thousand VCSELs – for example a chip with 500 apertures of 1 mm x 1 mm, glued and bonded like a normal LED.

VCSEL use in biometrics

Biometrical user identification methods are the most reliable and secure access options that are currently available. They are an alternative to complex password management tools for mobile device security, access control, and increasingly authentication for mobile payments and other transactions. The need for these solutions is driven by users increasingly managing all aspects of their digital lives via their smartphone and other mobile devices which accelerates the development progress.

Biometrics make use of human characteristics, such as specific structures within the iris, facial features or fingerprints. Sensors identify these characteristics and compare them with previously stored biometrical data. In order to function reliably in mobile devices, infrared light is required to illuminate the target area. This technology was already being used in access control systems, with most countries using it for immigration purposes. But with a growing miniaturisation of infrared LED technology the adoption in mobile and consumer devices has been gaining speed. Now VCSEL technology is complementing infrared solutions enabling the utilisation of these applications in a wider market.

New application fields

VCSEL technology is not a new invention, but has been used previously for data communication. Recently, a multitude of application opportunities in different markets have been identified. The decisive features of the surface emitter are the lower production costs compared to edge emitters and the superior beam quality but lower output power.

VCSEL technology is primarily used for application fields like smartphones, drones and Augmented

and Virtual Reality (AR & VR) devices where high-speed modulation is an advantage. 3D sensing applications such as facial recognition, especially for consumer devices, are viewed as key market drivers.

LEDinside anticipates that the global infrared laser projector market for mobile 3D sensing is forecast to grow to around $1.9billion by 2020.

VCSEL operating principles

The beam shape of a VCSEL is a circular spot, compared to the elliptical shape of FP-EEL (Fabry-Perot Edge Emitting Laser) and DFB (Distributed Feedback laser diodes). The optical resonator of a VCSEL array is only 4µm, compared to approx. 600 – 1200µm for FP-EEL (depending on the optical power) and 1000 – 2000µm for a DFB (depending on the optical power).

Compared to the temperature sensitive wavelength of an FP-EEL, VCSELs suffer way less wavelength shift under the influence temperature changes.

VCSELs can be modulated with high frequencies, making them useful for optical fibre communications.

In addition to the high beam quality of low-power VCSELs, an important aspect is the low beam divergence, compared with those of edge-emitting laser diodes, and the symmetric beam profile. This makes it easy to collimate the output beam with a simple lens, which does not have to provide a very high numerical aperture.

Much higher powers can be generated with VCSEL arrays. A VCSEL array with many thousand emitters (with a spacing of some tens of microns) can emit several tens of watts continuous-wave.

The effective beam quality is, strongly reduced in this case, as the emission comes from a larger area while the beam divergence equals those of a single emitter (which is, although still substantial, smaller than for an edge-emitting laser).

Such devices can generate high output powers with a high wall-plug efficiency and thus compete with diode bars and (combining multiple arrays) even diode stacks based on edge-emitting semiconductor lasers. Their emission linewidth is very small, and the emission wavelength has a lower temperature dependence than those of a conventional laser diode. Quite high peak powers are possible in pulsed operations with nanosecond to microsecond pulse durations.

Mobile 3D sensing

Current solutions for mobile 3D sensing include structured light and time of flight (ToF). One of the most recent smartphone models uses structured light with its dot projector producing several ten thousand dots of infrared lights on the face. Then the infrared camera receives the light reflected back from the face to create a 3D facial landscape.

Additional application fields include autofocus and proximity functions in cameras, especially in smartphone cameras. 3D sensing is also being integrated with AR and VR – for smart glasses or future smartphones and other mobile devices, including drones.

Due to its broad range of advantages such as a very small footprint, relatively low costs, optical efficiency, low power consumption, wavelength stability and high modulating rates, VCSEL technology could be key for a wider adoption of applications such as 3D sensing in the mass market.

Although the technology offers many advantages compared to existing technologies, it is not the best solution for all segments. It should therefore be viewed as an expansion of infrared and other light-based technologies. In order to help customers and clients choose the best suited solution for each application field, leading providers of optoelectronics components are looking to complement their infrared technology portfolios with a growing number of VCSEL solutions.

VCSEL technology can be used in numerous applications including a wide range of markets for end customers. The technology is primarily deployed for application fields where high-speed modulation is an advantage – like cameras or biometrics.

There are already first application examples with VCSEL available in the consumer mobile device segment.

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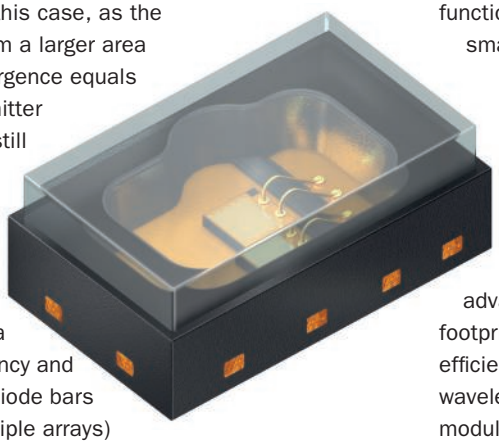

Above: The PLPVQ 940A VCSEL from Osram

INFRARED LIGHT SOURCES – FEATURES IN COMPARISON

	IRED	EEL / DFB	VCSEL Array
BASICS	Incoherent light Lambertian emission	Coherent light Directed emission	Coherent light Directed emission
POWER SCALING	Scales with chip area	Scales with chip length	Scales with chip area
PACKAGING	Simple packaging	Complex/large packaging	Simple packaging
SPECTRAL WIDTH	Broad emitter	Line emitter	Line emitter

Intelligent audio

Nokia is bringing spatial audio to mobile phones without requiring hardware and design adjustments. By **Neil Tyler**

As more and more consumers look to film their experiences and share short-form videos through their mobiles, it's fair to say that while camera technology has continued to advance, the audio quality of many videos has tended to remain poor.

"Audio technology on consumer devices just hasn't kept pace with the innovation we've seen in video and image capture," suggests Paul Melin, VP of Digital Media at Nokia, "and we think that it's about time that changed."

Melin believes that customers are keen to 'elevate' the quality of the audio experience and to that end Nokia has developed 'intelligent audio' that, "can dynamically target and track the desired source of sound. It provides a tremendous opportunity to enhance the user experience and to enable phone manufacturers to differentiate their products in a crowded market."

Originally developed for use with Nokia's virtual reality technology, Ozo audio is focused on the mobile space.

"When the VR market's growth wasn't as quick as originally hoped we started to focus on new use cases,"says Melin.

"OZO audio is intended to provide an immersive audio experience where you can hear the sound from the right direction. We want to improve the quality of user generated content by focusing on the audio direction.

"Our software has been designed to be flexible so that it can tune our algorithms to the microphone placements that the device manufacturer has in their device," Melin explains, which means you can, "zoom and focus on a particular person in a scene where people are talking or playing an instrument.

"The technology is able to capture and deliver a natural sound experience within one degree of accuracy, similar to how the human ear works. It can reduce distracting background noise and captures sound, it can adjust the audio to a specific part of the screen and select what matters. OZO also allows users to maintain audio focus on moving people or objects and automatically follow a sound source with audio focus parameters controlled by object recognition.

"AI has a big role to play in mobile audio and with OZO audio it is possible to teach the software to understand the scene being shot and make more intelligent decisions as to how to control and direct the audio."

OZO audio is the company's first licensed technology.

"Spatial audio enables consumers to capture true to life sound that accurately reflects the original event by using multiple microphones to record the depth, direction and detail of sound," Melin contends. "It is an industry-leadfing solution for capturing high quality audio on consumer devices and can work with as little as two microphones."

Melin believes that the opportunity to bring spatial audio to a broad range of smart phones is a great opportunity and, crucially, the company's intelligent audio does not require hardware or design adjustments.

"Audio technology on consumer devices just hasn't kept pace with the innovation we've seen in video and image capture."
Paul Melin

"Because Ozo is a software-based technology and not reliant on specific microphone configurations or placements, there are very few limits when it comes to what cell phone or camera hardware can use it, which means that virtually any manufacturer can license the software from the company for improved audio," he explains

Melin believes that the use of intelligent audio, imaging and video technologies will completely transform the way in which people capture and share their experiences.

"This includes 360 video and other immersive formats. Using AI and machine learning to automatically create richer experiences in familiar formats will now be possible without having to put hours into editing images or videos," he suggests.

"Consumers want the sound in their videos to be just right, and they want to be able to focus not only on the relevant audio sources but suppress unwanted noise."

OZO audio recordings support the most common audio formats in use, like stereo AAC, so it will be possible for users to share content or post videos on social media and, crucially, no special playback equipment is required.

"OZO audio is a much more immersive and engaging experience and I believe it takes user generated content to a new level where the audio finally stands side-by-side with the pictures," Melin concludes.