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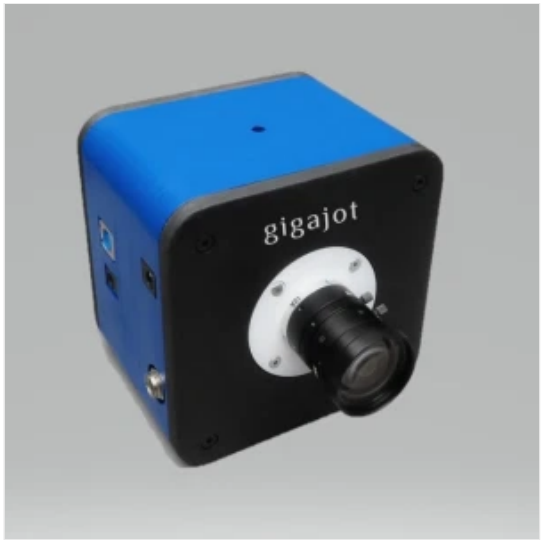
Heard of the CIS? Meet the First QIS

By **Don Scansen < https://www.eetimes.com/author/don-scansen/>** 05.23.2021 0

A company that may be relatively unknown to most outside the imaging field **recently announced its first products < https://www.prnewswire.com/news-releases/gigajot-unveils-worlds-first-commercially-available-quanta-image-sensors-301293648.html?tc=eml_cleartime>** . The Gigajot team invented and has been developing quanta image sensors (QIS) since well before the company was founded in 2017. The QIS acronym will sound a little like the much more familiar *CIS* or CMOS image sensor. This is the evolution (or perhaps a revolution) of CMOS image sensors, a truly ubiquitous technology.

Gigajot was co-founded by researchers Saleh Masoodian and Jiaju Ma in a spinoff from the Thayer School of Engineering at Dartmouth College in New Hampshire.

Massoodian and Ma were PhD students mentored by another company principal who is known to even the most casual of imaging technology buffs and non-techies as well. **Eric R. Fossum recently received an Emmy for his work in the development of image sensors < https://www.eetimes.com/isscc-day-2-we-can-see-clearly-now/>** and appears on the company's list of advisors along with Ron Adner.



< https://www.eetimes.com/heard-of-the-cis-meet-the-first-qis/qis-camera-dev-kit-gigajot/>

QIS camera development kit (source: Gigajot)

First silicon

The prehistory of the first Gigajot products probably goes back to **Fossum's slide deck outlinging the history of active pixel image sensor history from 2008. < http://ericfossum.com/Presentations/2008%20Jan%20CMOS%20Image%20Sensors%20Past%20Present%20and%20Future.pdf>** His slides cover imaging technology in the '60s that pre-dated the charge coupled device (CCD) — what was once the solid-state imaging workhorse. Fossum's timeline covered all the major milestones that get us up to the point of dense, high megapixel count sensors. Fast forward to 2008, and the image sensors of today are little changed, except for pixel size and count.

In that talk, Fossum noted the power of marketing with respect to technology with the point "If you can't fix it, feature it." For the future of imaging technology he posited that the next generation of imaging required a paradigm shift driven by the market.

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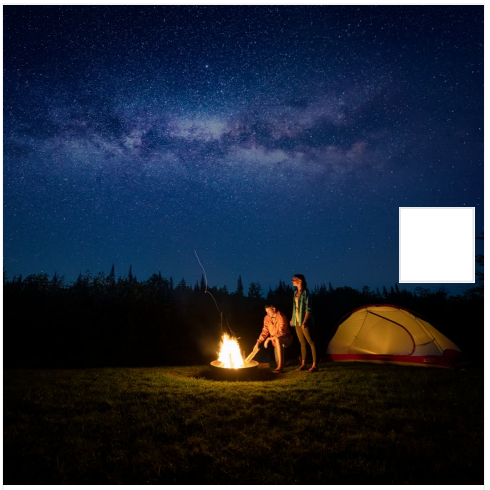

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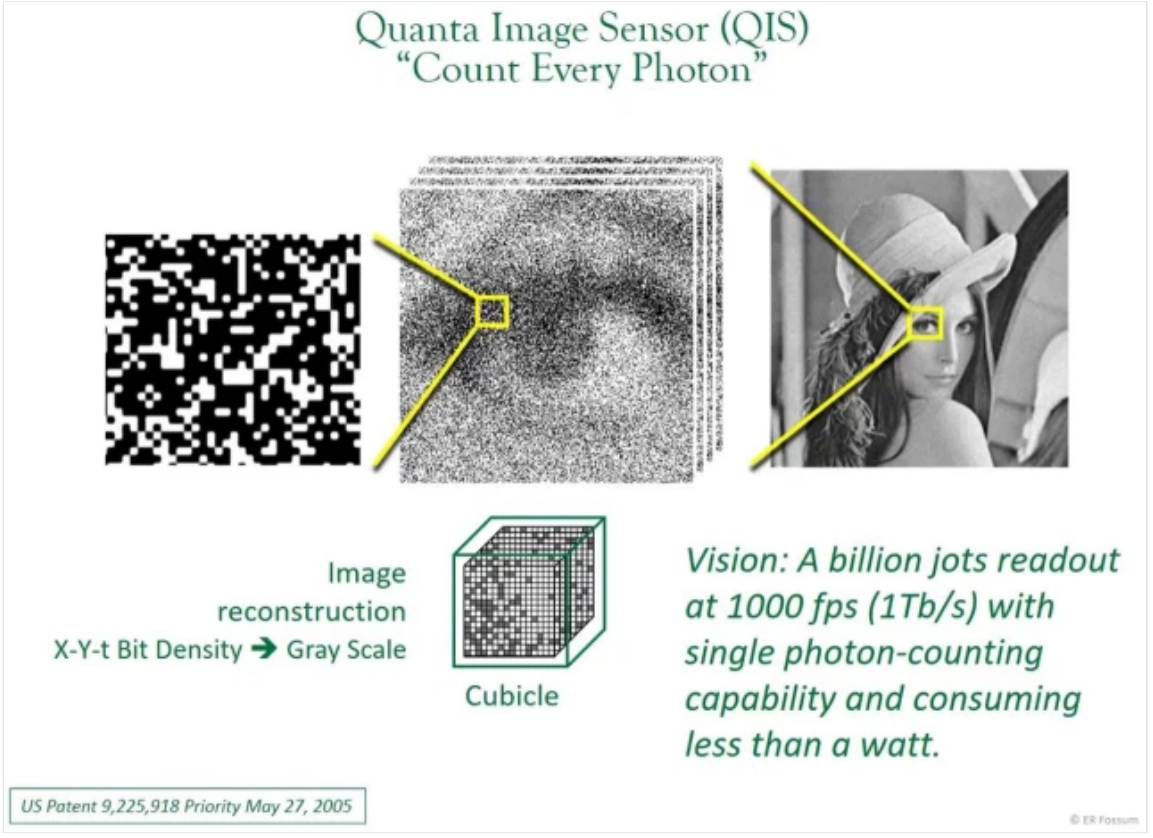
He signed off his conclusion slide with “Jot-based sensors may be interesting.” And here we are.

In that 2008 presentation, Fossum indicated his keen awareness of the importance of not only the market but the *marketing* in the success of a new technology. Using *jot* to describe a new type of imaging product protected the territory of a very small detector element, leaving little room for competitors.



< https://www.eetimes.com/heard-of-the-cis-meet-the-first-qis/qis-sensor/>

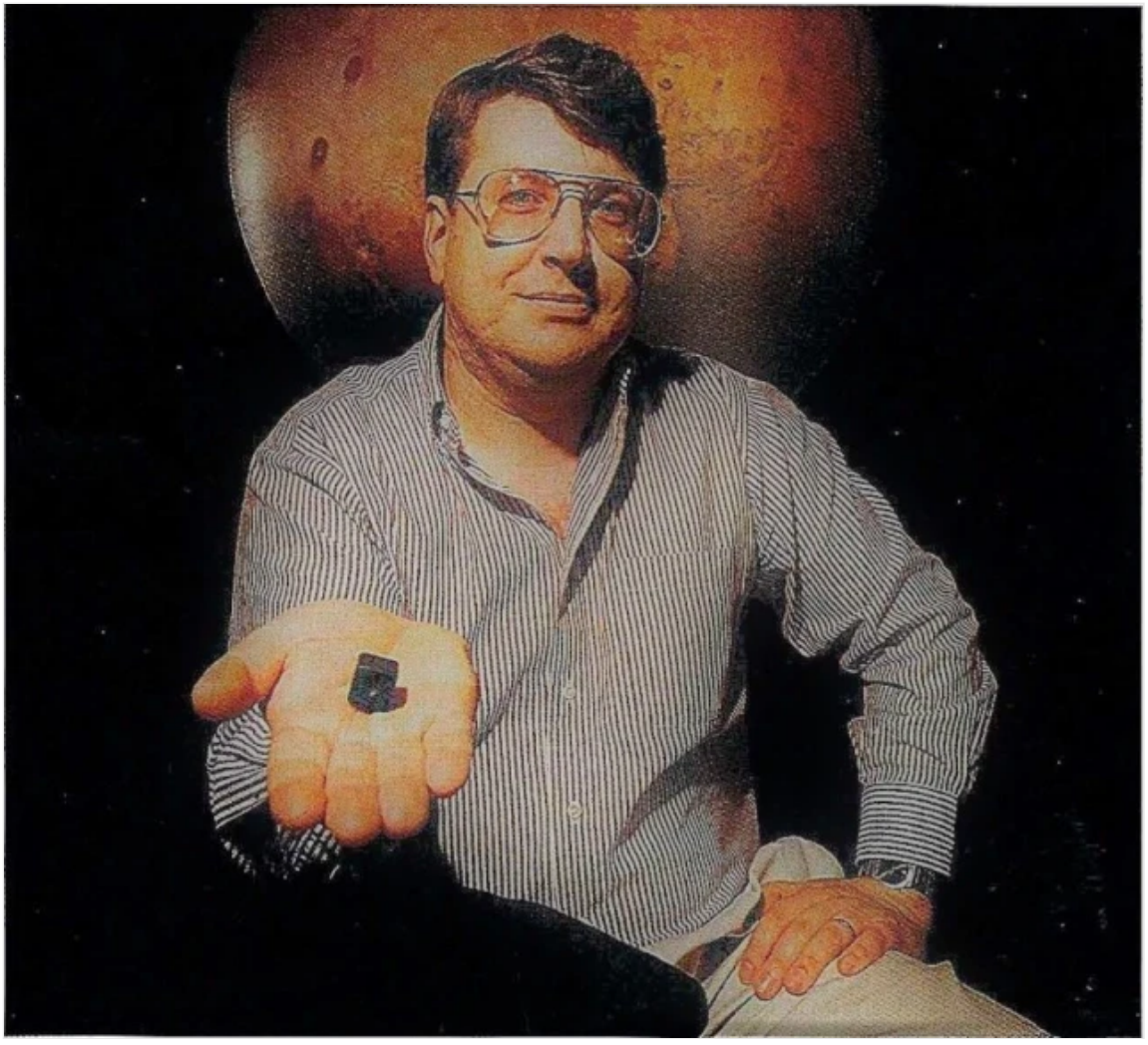
Slide from Eric Fossum’s lecture “Inventing the CMOS Camera and the Quanta Image Sensor” given at University College of Cork (Source: E.R. Fossum) (Click on the image for a larger view.)

It is akin to the origin of Google from *googol*, an extremely large number another brand not easy to best. With fewer letters and correct spelling, the jot-based imager deserves the accolades. Only time will tell if the term enters the vernacular in a way in any sense paralleling our current overuse of the term *google.*

The NASA nexus

The path to the CMOS image sensor everyone with a cell phone enjoys today began at NASA's Jet Propulsion Laboratory (JPL) at the California Institute of Technology. They were not the only group in development and surely the imaging community that developed along with friendly competition played a big role.

But a significant portion of CIS development came out of JPL. The motivation was lighter and more power efficient solid-state cameras for spacecraft.



< https://www.eetimes.com/heard-of-the-cis-meet-the-first-qis/qis-lightweight-camera-jpl/>

The original dream of a lightweight camera for space eventually fit into a cell phone as well (photo credit: Amy Etra/BusinessWeek)

From JPL, Photobit was spawned for commercial development. Some of the first CIS products were webcams. And where would we be in 2021 without our webcams for work-from-home?

Photobit was acquired by Micron which became Aptina which was later absorbed by the ON Semiconductor imaging division.

Back to the future

Several well-mentored technologists later, and we have a return to the roots of scientific imaging as the Gigajot products are intended for "high performance imaging applications such as scientific, medical, defense, industrial, and

space." The story arcs back to its origins. And the company does too, as Gigajot is now located in Pasadena, just a short drive from JPL.

Photography traditionalists and perfectionists will both appreciate the concept of the jot imaging concept. The goal was to create a truly digital film.

As Fossum noted in a 2018 DP Review interview, **"Because it's binary in nature, its response is comparable to old photographic film." < https://www.dpreview.com/interviews/9385721576/perfect-sensors-may-be-possible-but-might-not-come-to-cameras>**

Although acknowledged as the inventor of the active pixel sensor technology that forms the basis of most of today's detectors, Eric Fossum is ever careful to recognize others for the achievement of the current state-of-the-art of digital imaging: **"Where it is today is the result of the input from thousands of engineers from different companies who've contributed towards where we are now." < https://www.dpreview.com/interviews/9385721576/perfect-sensors-may-be-possible-but-might-not-come-to-cameras>**

Living in a world where it pays to be conscious of nearly constant surveillance by image sensors, it might be hard to imagine that even more caution might be necessary in the future. But as DP Review summarized the work of the Gigajot team, read noise reduction to the point of reliably counting individual photons has opened up "the possibility of cameras that could perfectly describe the light in the scene, even in near total darkness."

As we get to an era of even more sophisticated imaging, there is some comfort in knowing that the brains behind the technology are raising concerns. Fossum has highlighted the unintended consequences of advanced imaging. At the last ISSCC, another icon of solid-state imaging, **Albert Theuwissen, used his plenary talk to promote those concerns through the concept of "responsible innovation," a highlight of that conference. < https://www.eetimes.com/designline/soc-designline/>**

The Gigajot team will present at next month's VLSI Symposium. For some detailed insight into the basis of the technology, check **the paper published in 2017 < https://www.osapublishing.org/optica/fulltext.cfm?uri=optica-4-12-1474&id=377343>** describing a backside illuminated sensor die stacked with a readout chip and using a pump-gate jot. There is also an upcoming **Electron Device Letters paper for June. < https://ieeexplore.ieee.org/abstract/document/9402860>**

The VLSI Symposium paper will expand on the earlier developments: "A Photon-Counting 4Mpixel Stacked BSI Quanta Image Sensor with 0.3e- Read Noise and 100dB Single-Exposure Dynamic Range."

The technical papers add credibility and weight to the product announcements. Cutting edge, deep tech alongside savvy marketing is a rare combination. And probably a winner.

— This article was originally mis-attributed to someone other than Don Scansen. We regret the error. -ed.

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Don Scansen has devoted over 20 years to supporting patent owners with his technical expertise in semiconductor technology and related fields. The IP consulting journey drives a keen interest in the news and trends that are of interest to a broader audience. He is most readily found lurking on LinkedIn or reached by email at eetimes@semicondr.com

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