A Turning Point for Embedded Vision

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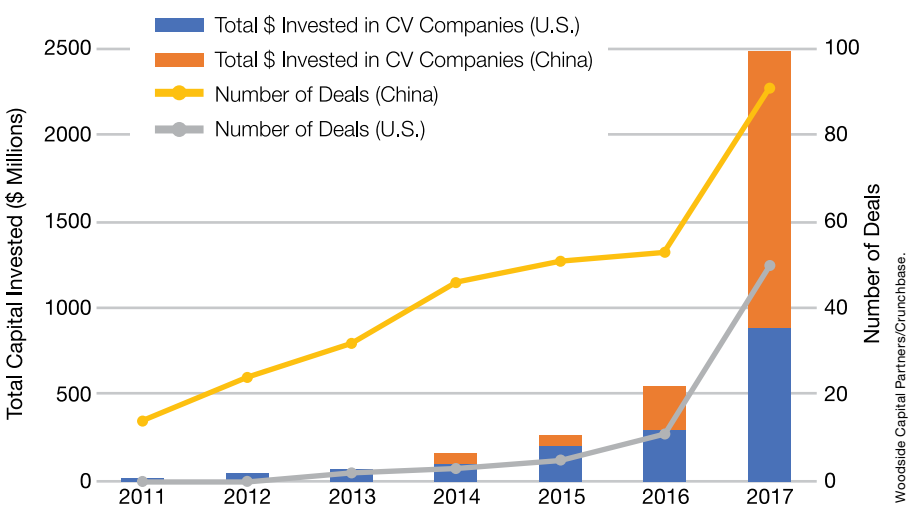
In recent years, "embedded vision" has become a ubiquitous term in the industry. Open any vision trade magazine or visit a conference and you're sure to come across promotions of embedded vision cameras, processing architectures, development kits, and accompanying services. Many traditional players in the industrial imaging industry now tout the capabilities and expertise of their embedded systems. This is with good reason: The influence and capabilities of imaging have moved beyond traditional application areas — which on the industrial side include factory automation, logistics, traffic, and microscopy, and on the consumer end include mobile phones, tablets, web cams, and surveillance and action cameras.

More recently, other sectors — notably home automation and robotics — are turning to imaging, specifically embedded imaging. But herein lies the dilemma: Can we assume that all companies that have grown in traditional industrial or consumer imaging markets have the know-how to help these new prospects deploy imaging?

Although these new market opportunities seem to have surprised some industry veterans, the increased imaging needs of new verticals were predictable and find their origins in the innovation tied to peripheral technology that has been developed over several decades from a multitude of markets. Case in point: It's hard to imagine a booming home automation industry — one



China versus U.S. investment in vision companies between 2011 and 2017. CV: computer vision. ▼

Meet the authors

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Sebastien Dignard, president of ienso Inc., has over 15 years of imaging experience. As the former CEO and president of FRAMOS, he established the company as one of Ottawa's fastest-growing businesses. Founded in 2003, ienso accelerates the deployment of innovative imaging and wireless products in a wide range of verticals, including IoT, home automation, automotive aftermarket, drones, professional entertainment, home robotics, and remote surveillance and security.

Challenges Faced by Embedded Vision Markets

Challenge/ Market	Machine Vision/ Industrial	Consumer Electronics	New Embedded Systems	Slight Advantage
Quantities	Between 1000 and 25,000 per year. Mostly localized production, flexible, low to medium degree of automation. Quick turns for numerous lines.	Between 250,000 and millions per year. Processes optimized for high volume and focused attention.	Between 10,000 and 500,000 per year. Production facilities need high throughput, flexibility, but lean organization.	None
Time to Market	Lower prioritization. Can interfere with customer-specific projects. Products are often technology driven, not market driven.	Critical KPI. Cycles are often measured in months, and competitors are quick to surface. Imaging innovation is mostly built to spec.	Highly competitive. Need quick time to market but also quick evolution following launch to preserve advantage.	Consumer
Product Life Cycle	Multiple products advertised and positioned. Product life cycle can be over 10 years and EOLs have serious impact.	EOL decisions can happen quickly with little due process. Product life cycle can last between 1 and 5 years and is often dependant on one major client.	Some applications need to offer longer life cycles. Need ability to reuse hardware design and to be innovative in software.	Industrial
Pricing/Margin	Machine vision was built on highly engineered products, and margins reflect this.	Due to high volumes and price-sensitive target markets, design-to-cost is key.	Companies have been exposed to and require cost points from consumer, but may pay a little more for access to elements such as support and life cycle.	Consumer
Support/ Documentation	Very well-documented products. Technical support team services numerous customers.	Minimal support and documentation because some technology is customer- or application-specific. Application engineers support design-in for high-volume customers.	Targets mostly SMEs with little imaging know-how. Interface design often according to custom spec.	Industrial
Technological Innovation	Originated in areas such as FPGA, CCD, throughput, and processing capability for flexibility in application.	Originated in areas such as CMOS, ISP, and SOM, with focus on cost. Application-specific designs.	Need ingenuity to combine cost-effective design with product flexibility capable of differentiating both at the HW and FW levels.	Consumer
Production Capabilities	Historically modular in approach because many models need to be built in small batches. Cost is relatively more expensive.	Limited flexibility in options. Off-shore facilities, centralized in Asia due to consumer manufacturing trends. Cost optimized for large volume.	Target verticals typically need smaller quantities but look for the price points and capabilities of Chinese manufacturers.	Consumer

KPI: key performance indicator; **EOL:** end of life; **SME:** small to midsize enterprise; **HW:** hardware; **FW:** firmware; **ISP:** image signal processor; **SOM:** system on module.

that gave rise to the visual doorbell — without effective and high-speed wireless technology.

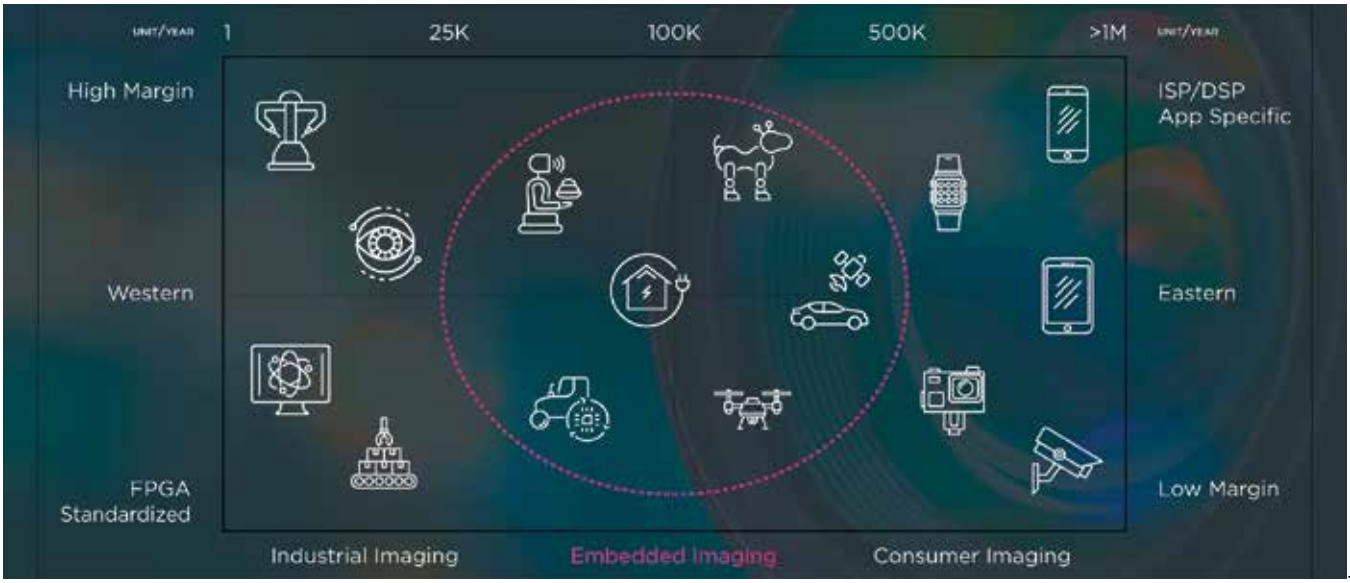
Verticals such as home automation, robotics, autonomous vehicles (encompassing delivery robots, production logistics conveyor platforms, and the automotive aftermarket), precision farming, "prosumer" equipment (drones and robotics), and interactive toys are incorporating more and more imaging. The main reason for this may be because they can now exploit its full potential, thanks to the advent and evolution of integrated technology enablers that include wireless, AI, the cloud, edge computing, CMOS image sensor technology, and processing innovation (SOMs, ISPs, DSPs).

Making the pivot

These new verticals offer opportunities that both traditional machine vision/industrial and consumer imaging players would like to capture because of overall growth potential and profit expectations. As they sell into these markets, both of these groups of players believe they can amortize the technology and capabilities they have already developed — but they face challenges rooted in the founding principles that have made them successful in their core markets (Table 1).

On the one hand, many machine vision companies had to engineer their products in a way that enabled integration into many different verticals — and this required FPGA (field-programmable gate array)-based designs. On the other hand, the consumer imaging companies were able to design one image sensor with a DSP/ISP, due to the high volume and focus on their applications. In these cases, one player has roots in expensive FPGAs while the other has cost-effective but inflexible designs — making them both unnatural fits for some of embedded imaging's most promising markets.

No one can predict who will be able to pivot and dominate the embedded imaging market successfully, but the eventual market leaders must under-



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▲ Embedded imaging in comparison to the traditional industrial and consumer spaces.

stand the needs and wants of the new prospects and so evolve in a changing market space as they address these growth-ready market segments.