

STRATEGY ANALYTICS INSIGHT

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Automotive 3D Vision: Stereoscopic Systems Boost Potential Market for Camera Chip Vendors

Snapshot

It has just been announced that Takata, the global automotive safety systems supplier, is to invest \$4 million in Tyzx Inc., a Californian-based 3D Vision company, which has previously seen investment from such luminaries as Microsoft co-founder, Paul Allen. Although 3D stereoscopic vision has been pursued for many years on-and-off by the automotive industry, monocular camera systems have dominated the market due to their lower cost. Strategy Analytics sees signs that the time may, finally, be coming for 3D vision systems within production vehicles.

Analysis

As a developer of 3D vision, Tyzx (pronounced to rhyme with “physics”) has excellent credentials, building as it does on more than 15 years of research at Interval Research, MIT, Harvard, and Stanford universities. Takata is a Japanese-headquartered global supplier of safety systems, including seatbelt systems and components, airbag modules and inflators, electronic sensor units and modules, and steering wheels and clocksprings. The combination is thus one to take note of, as a potentially successful blend of academic expertise with industry muscle and experience.

If the pairing of partners looks hopeful, then what about the market itself? Strategy Analytics has already made its views clear on automotive vision systems in general, identifying camera chips as one of the “hottest” sensor technologies in the automotive sphere. For 3D vision to see success, then a number of conditions will need to be met. These include:

- The traditionally high cost burden of stereoscopic vision will need to be dramatically reduced.

- Applications that benefit from stereoscopic vision will need to emerge.
- Demand for these applications will need to grow, either directly from consumers, or indirectly via automotive safety legislators.

Breaking the Cost Barrier

Tyxx is confident that it can provide stereoscopic vision at a price that the automotive industry is willing to pay, and Takata's investment shows that there is some credibility to that claim. Part of this credibility comes "free", in the form of Moore's Law of increasing semiconductor power: both the CMOS imaging chips and processing power required for vision systems are falling in cost, year-on-year, while improving in performance. The absolute cost difference between a stereoscopic and monocular vision system is thus constantly narrowing.

Such incremental improvements, however, are unlikely to be enough when taken on their own. Tyxx claims that by developing its own hardware solution for the basic 3D imaging functions, rather than relying on software approaches running on general-purpose microcontrollers, it can provide further significant cost savings. It has developed a dedicated full ASIC that can process VGA-class resolution images at frame rates of up to 200fps. As well as providing the hardware, Tyxx also offers the middleware required for its customers to develop their own applications.

Further potential cost savings are also claimed. By providing hardware-based 3D data, the amount of work that the application software has to do can theoretically be reduced. This may lead to less code lines having to be written, and less powerful microcontrollers required to run this code. Given that the greatest costs involved in developing applications such as Lane Departure Warning arguably lie in the application software generation, if this theoretical benefit of easier application development is realisable in practice it could be a big advantage to stereoscopic vision systems. Tyxx envisages that hardware demands for the application software could be quite modest, as well. Although its DeepSea G2 development platform uses both a Freescale PowerPC processor and Analog Devices Blackfin DSP, that - according to the company - is just so that it is capable of performing any task that may be required of it. A relatively simple end application may only require a 16- or even 8-bit microcontroller on which to run.

Finding the Applications

If there is thus an arguable case that stereoscopic vision systems are not ruled out on cost grounds, then are there the applications to support them? Strategy Analytics believes that there may well be. Complex vision tasks such as pedestrian detection are likely to work much better with stereoscopic vision, as well as in-vehicle passenger sensing for systems such as intelligent airbag control. An optical based autonomous cruise control system (as demonstrated by companies such as Mobileye), will be more robust and likely offer somewhat greater functionality with stereo vision. In addition, where millimetre wave radar and lidar are deployed today for obstacle detection, 3D optical systems would have the additional advantage of obstacle *recognition*, for more intelligent control of collision mitigation and autonomous vehicle systems

Generating the Demand

Safety applications such as those outlined above are generally popular with consumers, if appropriately priced and marketed. First-generation monocular optical-based systems, such as lane departure warning and blindspot monitoring are currently emerging onto the market. Strategy Analytics expects these to migrate from their current largely luxury SUV and sedan application areas to more mainstream vehicles over the coming years. As they do, the possibility of higher-functionality, stereo-based systems becoming available will give luxury brands and models a way of continuing to differentiate themselves in the market – a vital ability in order to maintain brand equities and carmaker profitability.

As well as consumer demand, further legislation in this area is likely. The European Union has already made its intentions on improving pedestrian safety clear. Although current proposed legislation is not technology-specific, it is certainly not possible to dismiss a future scenario when cameras for such applications become a mainstream technology. Tyzx believes that the stereoscopic approach has much to offer in such applications.

So, is the (3D) Picture Completely Rosy?

The picture painted above shows a market in which claimed cost reductions, feature benefits and consumer and legislative demand will slowly drive parts of the automotive vision market towards stereoscopic vision. This is a likely scenario, Strategy Analytics believes, but there are still some unanswered questions that need to be addressed. These include:

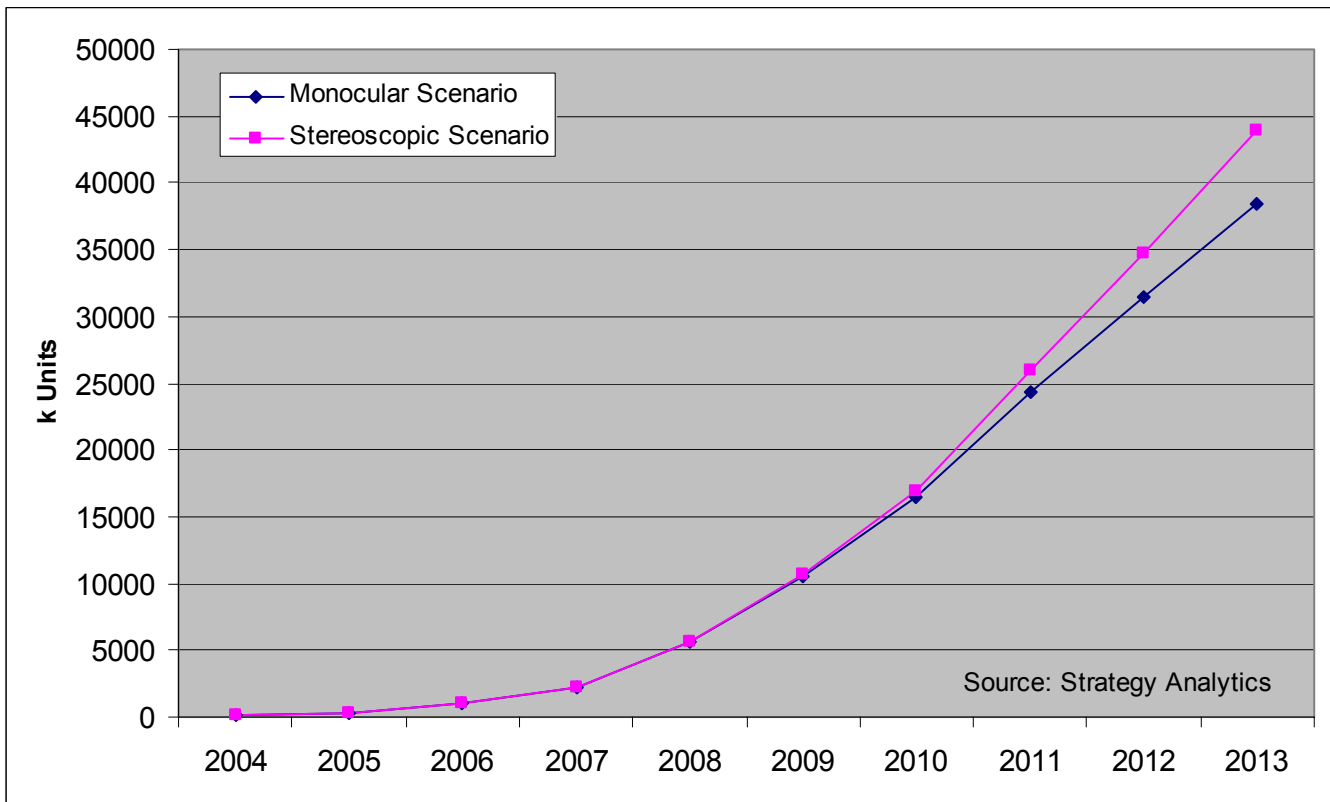
- A theoretical cost reduction is just that: theoretical. If, as Tyzx claims, the addition of 3D range data makes writing the application software easier, then this may prove a significant plus in favour of stereoscopic systems. The quality of Tyzx's middleware will also be key in this process.
- Stereoscopic systems are, by their very nature, a much bulkier package than a monocular system. The distance between the two cameras of a stereo system generally governs how far out it can discern range information. For a far-forward looking system on an automobile, which may need to look 100m plus in front of the vehicle, a baseline between the cameras of around 20cm may be required. This makes such a camera package significantly larger than competing radar, lidar and monocular vision systems.
- Consumer interest in safety systems is, Strategy Analytics believes, beyond doubt. What is more uncertain, however, is true willingness to pay for such systems. Research undertaken by Strategy Analytics' new Automotive Buyer Dynamics Service suggests that consumer willingness to pay for advanced safety features such as lane departure warning is currently at about the same level as other, more established safety features such as stability control. Vehicle manufacturers, however, typically charge much more for lane departure warning or blindspot monitoring than they do for stability control, and often package these systems as part of a larger, even more expensive bundle. Cost reductions of these systems, and less restrictive, more creative and synergistic bundling of features by vehicle makers will be required to maintain market momentum.

Implications

Adoption of stereoscopic vision systems could provide a 6 million unit boost to the market for automotive camera chips in 2013.

- One key implication of any shift to stereoscopic vision system on passenger vehicles is in the demand for camera chips. Based on a monocular scenario, Strategy Analytics currently estimates a likely future market of around 38 million camera chips installed in vehicles in 2013, across a range of exterior and interior applications. Changing the scenario assumptions to include a proportion of the high-end systems featuring stereoscopic vision boosts that forecast by around 14%, to 44 million.

Demand Scenarios for Camera Chips Fitted to Vehicles



Semiconductor manufacturers need to monitor the market for emerging applications which may drive demand for dedicated silicon, rather than general purpose high-power microcontrollers and DSPs.

The automotive image processing market is a potentially lucrative one for vendors of high-power microcontrollers. However, it now appears that dedicated hardware solutions may be viable in this market, thus potentially stealing demand away from these typically highly profitable, high-power general purpose micros.

- At one time, the Intel 486 and then Pentium processors were **the** processing power within a personal computer. Now, the value is shared between vendors of the central CPU, such as Intel and AMD, and vendors of dedicated graphics chips, such as Nvidia and ATI. Further changes are possible in the PC space, with companies such as Ageia developing dedicated physics-processing units to offload such intensive calculations from the main CPU.

The automotive industry has much it can potentially learn from the robotics industry.

In its 2004 report, “Automotive Camera Systems” Strategy Analytics recognized the emerging synergies between aspects of the robotics and automotive industries. Indeed, Tyzx has been involved in supplying hardware to the iRobot Corporation for its Wayfarer research project. These synergies, Strategy Analytics believes are increasing, with long-standing robotics issues such as making sense of an environment and then making decisions based upon that data now becoming mainstream automotive concerns.

Ultimately, the value will lie in the application layer software

Although developments in CMOS image sensor technology and 3D image processing are important, Strategy Analytics firmly believes that ultimately, the majority of the value will lie in the application software that provides the system functionality. Automakers and Tier Ones seeking to invest in automotive vision technologies would do well to invest in the best software engineers in this area, and buy or develop the intellectual property necessary to deliver systems that will delight consumers.

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