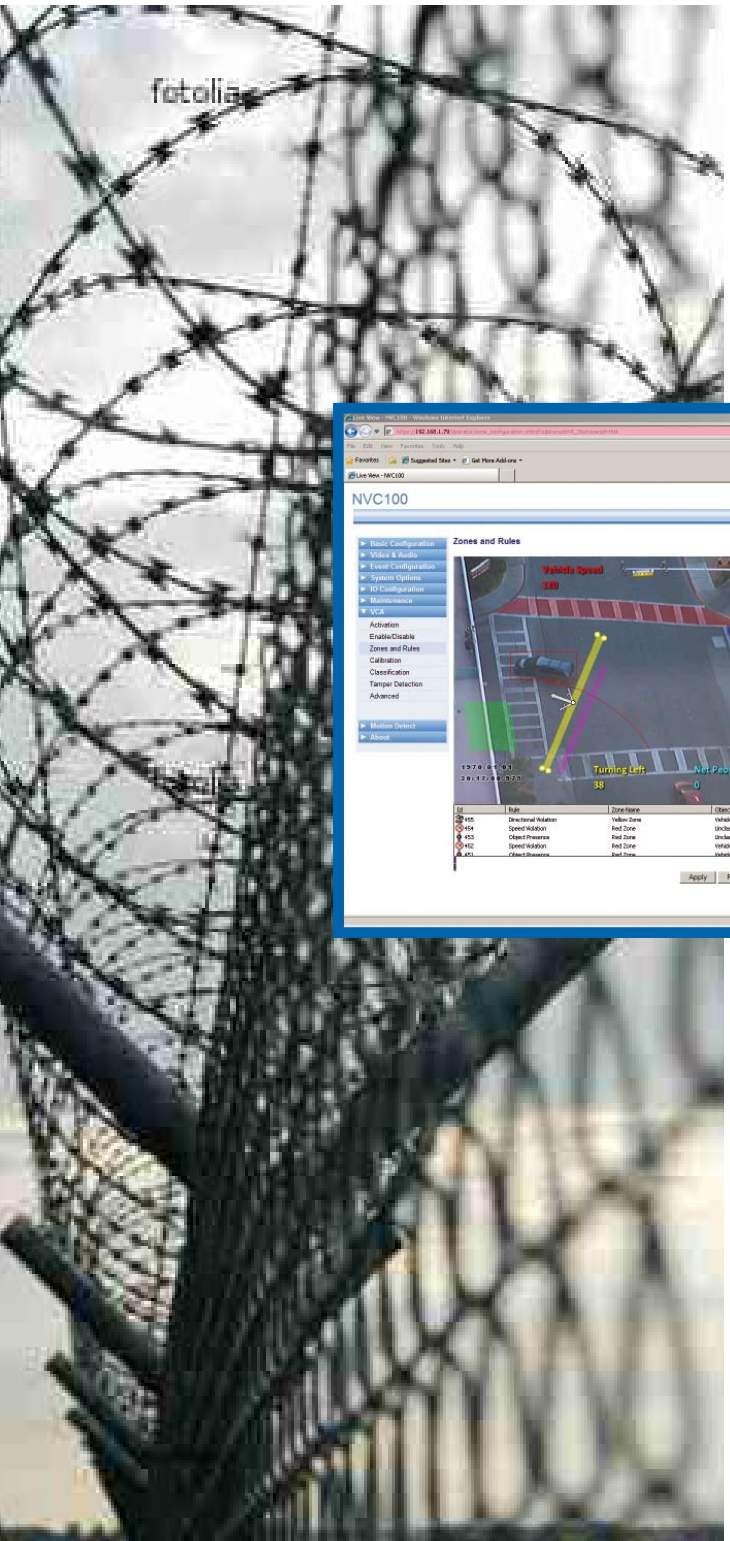
VIDEO MANAGEMENT

Looking Back & Looking Forward

Video Content Analytics: The Major Developments

Geoff Thiel, CEO of VCA Technology, pioneered Video Content Analytics more than 10 years ago when the company he headed then, PI Vision, developed one of the world's first video analytics systems. He went on to found VCA Technology in 2007 which recently launched its analytics software suite VCAsys. This article looks at some of the major developments over that period and takes a peek into the future to see where the market is heading over the next 10 years.



Geoff Thiel

The 'Double Knock'

If we look back 10 years to the video analytics projects that we were involved with back then, there were some very key developments that took place in central Government-backed projects such as the Amethyst system. Amethyst focused on tightening security in high security Category A prisons and other key government sites. To make the perimeter alarm facilities more accurate we worked with the then Home Office Police Scientific Development Branch (PSDB) to combine video analytics with the existing Perimeter Intruder Detection Systems (PIDS) in order to dramatically reduce false alarms being generated by the PIDS systems alone.

A typical PIDS system uses a microphonic cable stretched along the perimeter fence and uses digital signal processing (DSP) technology to detect important sounds, such as someone cutting through the fence, whilst rejecting less important sounds such as the fence rattling in the wind.

Other PIDS systems use infrared beams, microwave beams, buried cables and a host of other techniques to similarly detect intruders and reject false alarms. Unfortunately, prisons and other government sites are often located in remote and hostile locations where wildlife, high winds and torrential rain cause considerable problems with false alarms. None of the above systems are immune to false alarm problems particularly in bad weather.

We worked on the principle of the 'double knock' which is now widely used right across the professional security world. The principle was that the Amethyst system took feeds from multiple alarm systems and would only pass on an alert if the right combination of alarms was detected. Effectively, the analytics system we developed, analysed the video from the camera covering the fence zone that the PIDS alarm came from and would only pass on the alarm to the operator if it had verified visually that an intruder was present.

Very recently a similar technique was applied to a VCAsys pilot system for detecting passengers trespassing on railway lines (this included passengers changing platforms by jumping down onto the tracks and crossing that way just to save time). The specification required a system which could generate no more than two false alarms per month out of tens of thousands of possible movements linked to trains and people moving in and out of carriages and onto the

platforms in a busy station. With one camera on one side of the track feeding into VCAsys it was only possible to reduce the false alarms to a few per week. But with a second analytics camera on the other side of the track the system could cross-refer and eliminate false alarms, suddenly the double knock method enabled delivery of the necessary 0.001% false alarm rate.

This principle can also be applied within a single analytics channel by simply creating two zones in the field of view. If someone/thing crosses the first zone some distance away from a building this may put the system into high alert but the alert would not be sent unless that person crosses the second zone set right at the door of the building. It is possible that a dog or a piece of litter might trigger the first zone and then travel no further but it is unlikely that either of these things would cross the second zone to trigger the door alarm. Combining sensors, or combining multiple detection zones are then a key method of reducing false alarms to a level where the system adds real value to the end-user today.

Background Subtraction Method

The other major development used in Amethyst, which is widely applied in video analytics today, is the 'Background Subtraction Method' of segmenting tracked objects. The benefit of this method, compared to conventional Video Motion Detection (VMD) systems, is that it can track objects which stop or move very slowly, whereas VMDs cannot. This method is central to VCA Technology's VCAsys system although it has undergone considerable improvement since those early days. Essentially analytics software analyses an image, pixel by pixel, to assess what is static and what is moving. Through this analysis it is possible for systems to tell what is immobile and therefore can safely be considered to be background and what is moving, the so called foreground. More sophisticated algorithms are then capable of checking for different types of movement. For example, systems probably will not want to focus on the movement of tree foliage blowing in the wind but they will be interested in picking up the people moving around that tree at ground level. The Amethyst system included many other features including video stabilisation so that camera sway did not affect the analytics, lighting change compensation so that cloud shadows did not cause problems and also a fail-safe mode that shut off the video analytic verification if the visibility was too poor due to fog or rain.

Processing Power Requirements – a Barrier to Rapid Adoption?

Although there is some potential for error in the background subtraction method it is nevertheless a fundamental building block of good analytics systems today. Indeed, it is this pixel by pixel analysis which accounts for the massive computer processing power that systems still require. 10 years ago, digital CCTV systems often used reduced frame rates and lower resolutions. However nowadays real-time 25/30 frame per second (FPS) video at full D1 resolution is common and recent innovations, such as progressive scan and megapixel cameras, simply compound the computing load. So analytics systems today are processing many times more pixels than they ever used to and they must process these with ever greater speed and efficiency to keep up with the accuracy levels being demanded of them.
VCA Technology has worked hard to find Central Processing Unit (CPU) efficiencies so that it is able to comfortably co-habit on the CPU of edge devices like encoders and network cameras. It uses just 20% of the processing power of a standard DSP CPU whereas some systems demand a whole second DSP CPU or a large proportion of a standalone PC all to themselves.

10 years from now

If you look forward 10 years then there appears to be one near certainty in terms of processing power of computers. According to Moore's Law performance doubles every two years so CPU usage will be less of an issue within a few years, despite the increased use of multi-megapixel & HD cameras. You only have to look at developments in the DSP and Integrated Signal Processing (ISP) chips used in cameras to see that more and more processing - from encoding to compression and analytics - can be done at chip level. This, in turn, will enable more of these tasks to be performed inside smaller devices such as cameras and encoders.

Chip manufacturers are already focusing hard on doing more video processing in hardware so that the programmable part of the chip has more space to do analytics-related processing. As chip manufacturers start working more closely with analytics software providers it is conceivable that analytics will become more widely available at virtually mass market prices within 10 years.

This trend towards mainstream adoption will also force some consolidation in the analytics market as specialist analytics providers, which have commanded a high price for their expertise, will find their position under attack. They will be challenged by well-constructed analytics software suites which are easy-to-configure and highly adaptable to specialist analytics tasks such as understanding people traffic flow through a shopping centre (to inform better marketing/sales promotion) or spotting specific criminal behaviours.

For a fuller glimpse into how analytics may be put to work in the future you need to look to the Asia Pacific region where we are already seeing it being used in a 'smart home' environment to help control lighting to create the desired mood within specific parts of the home at specific times of day.

Users ought to be able to deploy a system without having to call in an expert to install and configure the system. I see it as VCA's raison d'être to make analytics as easy as possible for a person to use to enable him to be alert to all things he needs to know but might ordinarily miss. As such it should be a single set of eyes combined with an easily configurable analytics system which can be tailored to meet any visual analytics challenge.

But some shifts may still require the next generation of people to force a change of mindset and more widespread adoption. We may even rely on the arrival of 'Generation Y' into positions of influence which enable them to control necessary budgets, to deliver mainstream adoption. The other trend will be consolidation of analytics vendors into larger IT players that already have a stake in the market today such as Cisco, IBM, Honeywell and Unisys who will be buying more video analytics specialists in the coming years. But why are these big IT players looking at this technology?

Video analytics has already spread outside of the security domain with many retail organisations using the technology for footfall analysis and marketing data. However, you can imagine a time when video analytics will be used in search engines and net applications to quickly access specific types of video content, this in turn will drive greater adoption of the technology by network providers so bringing it to the mass market and significantly reducing its cost. The security market will give to the world an outstanding technology which in turn will deliver back a very low cost implementation; analytics can then become a standard offering in all digital cameras and DVRs in much the same way as VMDs have over the last few years.

I also believe some specialist service and consultancy-driven analytics offerings and perhaps also some that are aligned with specific vertical sectors, will survive and thrive in niche markets even 10 years from now.

Summary

The market has moved on a good deal since my involvement with some of those early analytics systems but perhaps the most significant change has been the widespread commercialisation of this technology in recent years. A combination of affordability, usability and education of the end-user will continue to push video analytics into the mainstream within the next few years and we intend to play our part in accelerating widespread market adoption during this period in all three of these areas.

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