DPS CAMERA TECHNOLOGY :
IS THIS THE BREAK THROUGH WE HAVE BEEN WAITING FOR?

By

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This summer will see the launch of the Baxall Hyper-D range of cameras containing a new breakthrough in camera technology, improving on many of the weaknesses in current technologies in the market. For many years now there have been a number of issues facing the CCTV industry, particularly regarding colour surveillance cameras. These roughly break down into five key areas:

- Colour saturation – Accurate reproduction of colour under all lighting conditions
- Low light performance – The ability of cameras to capture images in low light, while keeping the amount of noise to a minimum
- Handling scenes of high dynamic range – Extremes in light levels from bright sunlight to dark areas in the same picture scene
- Blooming and smear from bright lights or spotlights

All of the above have been tackled in their own way with both traditional CCD and various CMOS, APS (Active Pixel Sensor) solutions with varying degrees of success, usually price dependent. These are also the barriers that have stifled the use of CCTV in more applications than current, and also limited the scope for the camera taking a more central role within the CCTV system.

A Brief Recap on Camera Technology So Far

CCDs have been around for many years now, and have improved in their performance over the years. However, if you take an objective look at the platform you will find that in general terms the following applies for cameras based on CCDs:

- They suffer from blooming and smearing due to the way the chip is designed and the way the pixels are read
- They rely on external DSP chips, not optimised as a system with CCDs, to produce pictures and features. These tend to be limited especially in their ability to interchange across a number of platforms
- They are based on analogue technology
- The external component count tends to be quite high even for a relatively simple camera
- They draw relatively high power

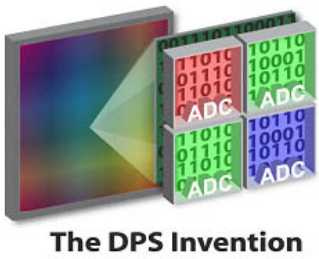
The CCD chip is available in many forms, and ranges from a ½" optical format down to traditional 1/3" and ¼" versions, with talk of 1/5" and even 1/6" versions coming through onto the surveillance camera market. Whilst the miniaturisation may seem welcome on the face of it, the problem for the security application grows as light performance and signal to noise ratios fall with smaller sensor areas, and hence picture quality tends to suffer.

A number of manufacturers now offer APS products based on a CMOS manufacturing process as an alternative to CCDs for image capture. Most of these APS sensors have yet to deliver the quality of picture demanded by the modern surveillance industry. In essence they operate in a similar fashion to the CCD sensor, but have an A/D converter built on to the chip. The problem with these devices is that low light sensitivity tends to be a problem because the nearest neighbour pixels produce noise, corrupting the signal before digitisation. There are also various motion and colour artefacts produced by the sensor. As a result they are usually not suitable for high-quality CCTV cameras. Interestingly enough, at the premium end of imaging a lot of the best digital still cameras - cameras used in space and defence optics - tend to be high end, high cost CMOS APS sensors, thus exploding the myth of the technology only being suitable low cost and low quality.

So there has been a great diversification between what is needed to do the job, and what is actually available to fill that need. That was until Pixim brought the Digital Pixel System (DPS) to the market, which has been licensed by Baxall – the only European manufacturer to do so.

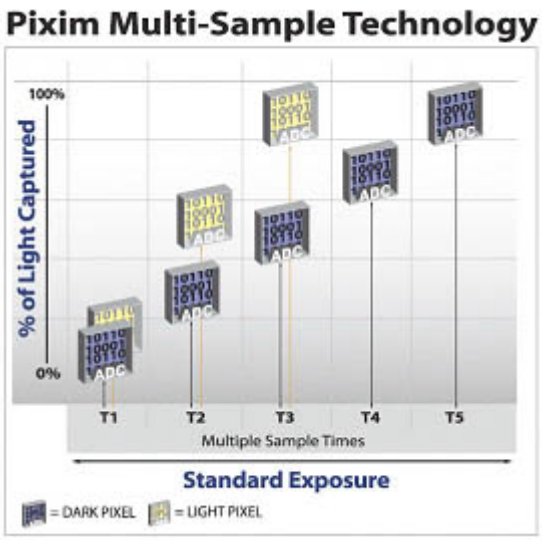
DPS TECHNOLOGY

DPS technology marks a fundamental breakthrough in imaging technology. Building upon technology developed at Stanford University in the 1990s, DPS is an image capture and processing system that provides high-quality pictures that have amazing colour reproduction with enhanced dynamic range. Greater dynamic range significantly improves image quality in scenes consisting of both bright and dark areas, making it more like the human eye when viewing surveillance images. At the same time the low light performance has not been sacrificed so the performance of is suitable for high-end colour surveillance cameras.



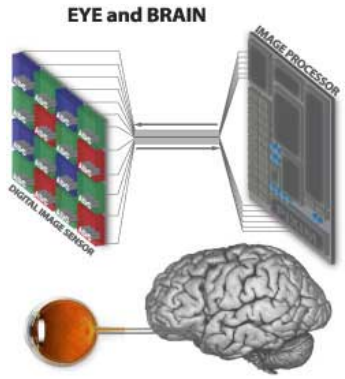
The DPS Invention

The core invention in DPS is the inclusion of an analogue-to-digital converter (ADC) within each pixel of the image sensor. The ADC translates the light signal into a digital value at the immediate point of capture, thus minimizing signal degradation and cross talk in the array and allowing for greater noise reduction methods. Once the data is captured in a digital format, a variety of digital signal processing techniques are used for optimal image reproduction.



DPS technology uses a technique known as “multi-sampling” to gather the information to achieve unmatched image quality and high dynamic range. Each pixel is independently sampled non-destructively multiple times in a single capture frame (which in video is typically 50 or 60 times per second). The imaging system determines the optimal time to sample and store the pixel information before the pixel is saturated and can no longer hold additional charge. In the graphic on the left, the light pixel is saved at time T3, the latest sample time before it saturates at 100 percent. The dark pixel builds up charge more slowly and uses additional time until it is sampled and stored at T5. The stored values of information (intensity, time, noise offset) captured at each

pixel are then processed in parallel and converted into high-quality images. In contrast, other technologies typically set one exposure time for the frame and sample each pixel at that time – resulting in images with some pixels that are underexposed (too dark) and some that are overexposed (too bright).



The digital image sensor and digital image processor function much like the eyes and brain in humans, with two-way real-time interactivity to capture the highest quality image possible. Just as the brain of a person walking into a dark room instructs the eyes to open the pupil to allow in more light, the digital image processor loads new code into the sensor to alter not only exposure times but the actual image capture algorithms. The result: the best possible picture given the specific image characteristics and lighting conditions.

Because each pixel has its own analogue-to-digital converter and the information generated is captured and processed independently, each pixel in effect acts as its own camera. The exposure time for each pixel is adjusted to handle the unique lighting conditions at that pixel location in the image sensor array. A product built with the DPS platform essentially has hundreds of thousands of individual cameras, each of which produces the best image possible. These images are then combined to create a high quality video frame or picture.

The sensor's architecture also means that highlighted area do not cause any blooming or smearing under extreme conditions, something that has plagued many forms of CCD sensors for years now. The upshot of the zero blooming and smear, is that it makes DPS the ideal technology not only for low light, or outdoor wide dynamic range scenes, but also will add a whole new perspective to traffic surveillance and ANPR (Auto Number Plate Recognition Systems) going forward, especially when you combine this factor with the imaging systems outputting video in excess of 400 VTVL resolution. Thus higher

resolution equals more detailed pictures. This could apply to ANPR system applications, and for instance to a camera looking at a stack of betting chips on a casino gaming table. The DPS technology is very versatile, and can be used anywhere where you would be looking for high resolution colour or monochrome pictures, depending on how you choose to configure and utilise the technology.

This system also comes with an embedded ARM 7 microprocessor, and external access is available to the image buffer contained within the architecture that could rise to a number of features and options depending on to the capabilities being targeted with new surveillance cameras.

There are also a number of other benefits that come with the DPS technology; these include features such as high-quality digital pan, tilt and zoom, genlock, and linelock amongst others. External control via a serial or parallel interface is also available, making the flexibility of this platform second to none.

WHERE NEXT? …THE HYPER-D RANGE FROM BAXALL

As imaging technology continues to migrate toward totally digital systems, Baxall's philosophy and and long history of camera manufacture provide the foundation for the new generation range of cameras 'The Hyper-D range'. This latest range utilises DPS technology to ensure image capture and processing to the highest quality in video and still cameras. In security and surveillance applications the technology with its picture quality and flexibility comes into its own having the capability to quite literally re-write the rules of what function, and what features a camera performs in the average installed system.

Once people start to use the first Hyper-D cameras, and become comfortable with the technology and its benefits, they will begin to understand that the platform gives them a number of enhancements beyond great pictures. Functions that have become to varying degrees a necessity on most camera specification sheets at the moment may well become redundant. The days of needing to have BLC (Back Light Compensation), PWI (Peak White Inversion), and many others, may well come to an end, as DPS technology makes many of those controls unnecessary. The user friendliness helps the installer and end

customer in many situations that have been traditionally hostile to the rank and file CCTV camera.

Situations like the reception camera looking over the reception desk, and out through glass windows have always posed problems to traditional 8-bit CCD cameras. In fact you can use the 8-bits of information to get good indoor or outdoor pictures but not usually both at the same time, especially on the sunnier of days. The DPS technology has 14-bits of dynamic range available to it, hence can easily outperform any of its nearest WDR competitors, without penalising the colour reproduction, or giving a bright blue haze around objects placed or standing in the brightly backlit window.

Beyond the first generation of cameras, the technology becomes even more exciting as people not only understand what it can do, but become more demanding of what the functionality and quality of a surveillance system should be. There is a move towards putting more intelligence in the camera, algorithms for all sorts of things are being developed, and such things as facial recognition, motion tracking and alarm handling could all become serious options once the full flexibility and programmability of this platform is understood, and camera designers get creative.

CONCLUSION

We are about to witness the introduction of a technology that will deliver a great leap forward for not only CCTV cameras, but the whole CCTV industry as well. It will set a new benchmark for image quality in the CCTV market, but will remain highly affordable.

The rule book of what is accepted or required for surveillance cameras could well be ripped up as the picture quality and flexibility of this technology is grasped by all sections of the CCTV supply chain from manufacturer to end user, and tomorrow's products with all their features and benefits to the surveillance industry are produced.

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