

# The trials and tribulations of designing a camera



A little over six years ago, the first product launched by GTC sponsors Videosys was a remote camera control system for broadcast cameras. This changed what had typically been a cumbersome, basic user interface into an easy to set up, simple to use, robust control system. Building on the same basic principles that enabled the development of the control system, the Videosys team have now turned their attention to designing a mini camera. Videosys Managing Director **Colin Tomlin** explains.

**I**ronically, the smallest camera on the set or OB, the minicam, usually takes the longest to set up. For live work you need to be able to get power and control to it, and video pictures out and back to the truck or MCR. This usually requires a plethora of other equipment and cables, such as fibre converters and power supplies, so in the end your mini camera is not so mini at all. Of course, there are companies that specialise in this line of work, who take the headache away from production, but what if we could design something that would make life easier for those guys as well as the non-specialist minicam users?

### Requirements of the camera

The first problem is the camera itself. Consumer cameras have changed the industry, offering fantastic HD pictures at a price aimed at the mass market, meaning that for broadcast they can practically be treated as disposable. However, for live broadcast, cameras such as these have shortcomings. Firstly, you only have an HDMI output; this is not necessarily a showstopper in itself as there is a lot of broadcast equipment that will now accept HDMI (Cobham's Nano transmitter being one), but the size of the connector and flexibility of the cable required suddenly make a mini system that much harder to design. Integrating the camera into the broadcast set-up makes everything a lot easier if you have HD SDI 1080i 50 (in the UK). Another disadvantage of consumer cameras is the problem of matching their images to the line cameras. Obviously, a 1/3" sensor is never going to match a line camera exactly, but if you have no control of the colours then it will never even be close.

So what about camera phones – they have tiny cameras? Yes they do; my smartphone takes fabulous pictures and the video on it is pretty good as well and yes, the lens is tiny. But – and this is a big but that no one thinks about – a smartphone has a pretty big processor inside, physically large as well as incredibly powerful, to enable it to do all the processing a modern phone requires. It is not possible to get an output stream of broadcast quality from them so, again, for live broadcast they are not practical.

So, what could we at Videosys do about this? Well, firstly we had to see if the rest of the industry was thinking along the same lines as us, so we quickly made a demo system for IBC last year. This was in the style of a helmet camera with a Cobham Nano transmitter clipped to the bottom. It generated quite a buzz and our notion that the Cobham Nano could be swapped for an integrated fibre unit depending on the job was also met with excitement. However, the big selling point was the degree of control offered – we were confident that the finished product would be able to be controlled from a Sony, Grass Valley, Panasonic, Hitachi or Ikegami remote control panel (RCP), making it familiar to users as well as cheaper, as you wouldn't need to purchase a new bespoke RCP. We also said the camera would be 1080i 50/60 and would have HD SDI output. Even better, in this mini camera you would have remote wireless racking (camera control) without the need for a cumbersome radio being carried separately, so pair it with a Nano and you have a very powerful product.

Now all we had to do was build it!

### Building a sensor

Like all good stories we start at the beginning, in this case with the camera sensor. There are plenty of companies making small sensors, some better than others, and we wanted something over which we could have total control. The mobile

phone market has brought more technology into the 'small camera' market but we needed something for broadcast quality. Sadly these companies don't sell in ones and twos so we had to make our choice carefully and order a large batch of what we deemed to be the best 1/3" CMOS sensor out there.

Next, the project became about how to interpret the light information from that sensor and turn it into a picture... and this is the really techy bit. Luckily we have our very own in-house FPGA (field-programmable gate array) engineer, who was tasked with designing the processor engine. He was to spend many hours incarcerated in a darkened room, whiling away the hours working out how to create a picture out of the mass of 1s and 0s on the computer screen in front of him. This was a slow process and every so often you would see a wee smile on his face and glean that a milestone had been reached... until, eventually, there on the screen was a full HD picture, in glorious full colour! Even better, we could control those colours, the black level and a range of essential commands from the RCPs, just as we had said we would be able to.

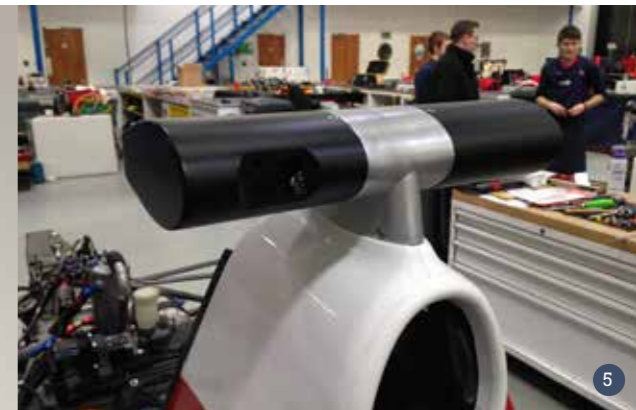
First prototype with an HD camera and Nano transmitter



### Flexible design

We had reached the point where we had the camera working on a big development kit in the office. What next? Well, this is where designing your own camera comes into its own, because the answer is: "Whatever you want!" We can basically make the camera any size and shape required. So, if a customer for example wants a cricket stump camera, it's no problem. We can build the boards so that the camera stands

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**IMAGES:**

- 1 The Videosys CNC machine making a metal casing
- 2 Formula Renault upgrading to HD onboard cameras
- 3 HD fencing camera with attachment bracket
- 4 BRF Veloview camera weighing less than 200g
- 5 Formula Renault Prototype wing with 2 HD cameras installed

on its end or the lens comes off at a right angle or with a low profile to lie flat against something. We are no longer constrained by the size and shape of consumer cameras but can instead offer a wide range of lens mounts or a fixed wide angle if size and weight are the issue.

It was this flexibility that brought Broadcast RF (BRF) to us to help in the design and manufacture of their 'VeloView' camera system. This is an HD camera with a Nano transmitter and battery all built into one housing that weighs less than 200g (quite something when you consider the Nano in its original housing is 140g). We were able to make the boards fit around the allocated

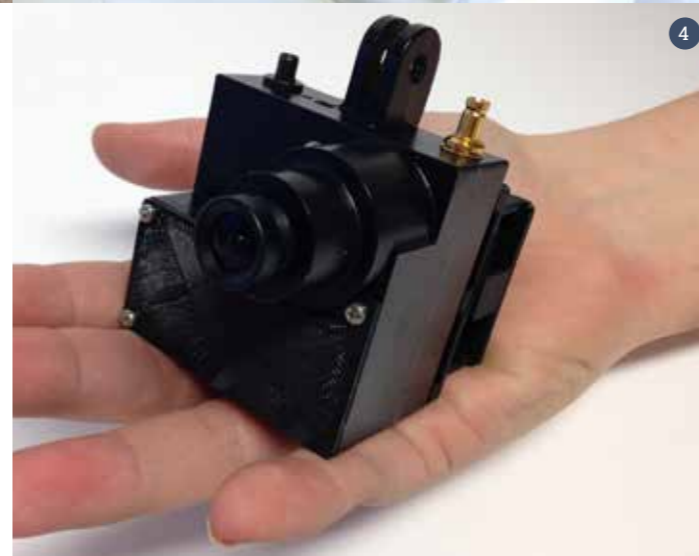


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space available and actually produced the metalwork in-house, using our own CNC (computer numerical control) milling machine. Just three weeks on from our first chat with BRF, they were in Paris with four racing bikes whizzing around the Velodrome with (as far as we know) the first live HD onboard shots in the sport.

Just after IBC, AMP Visual in France got in contact; they wanted to take the sport of fencing from SD to HD. We designed and manufactured in-house a bracket that fitted securely onto a fencing helmet and, neatly on top of that, perched our camera with a Nano tucked underneath, giving the viewer live HD pictures right from the heart of the action.

Then the Formula Renault World Series came to us wanting to take their onboard cameras to HD. Using the experience we had gained with British Touring Cars last year, we set to work to design a wing based on Renault's old wooden design and brought it up to date incorporating one rear- and one front-facing HD camera with a rotating cleaning film and camera-switching capability, powered by Cobham RF technology. All of this was once again designed and built in-house by our engineers using our camera board to make the cameras exactly as we wanted them.



**The next stage**

And where is all this leading to next? Well, we now have a camera over which we have total control of size, weight and, of course, processor. Currently it is as small as anything else out there but with the power and flexibility demanded by the broadcast industry. The next stage is to go even smaller; we have plans to launch another camera by Christmas that will have gone through the same design decision-making processes as the camera control and mini camera: What does the industry want? What does it currently have? What can we do to improve on what is already available?

Designing a camera from scratch has been a long and expensive process with a lot of learning along the way, but this determination to make something better than that which is already available is how our camera control system became the market leader. If we can make things better and easier for the industry then we hope to still be here in years to come. After all, it was this ethos that got our company started in the first place.

**Fact File**

Videosys is an RF specialist sales company, which designs and manufactures broadcast products and systems. With a combined 50 years of onsite experience in outside broadcast, the Videosys team are always happy to chat and offer advice on any aspect of the industry.

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