

High-performance traffic imaging for the next generation

Imaging solutions are used in a variety of ITS applications, such as automated tolling, safety monitoring, speed and red light enforcement, and ALPR. With each of these applications comes a demand for systems integrators to create simple solutions that can speed up deployments and lower costs.

A new solution might involve real-time video capture and post analysis via software rather than relying on expensive in-ground sensors that connect to systems that trigger cameras. Those systems are much easier to install and maintain as the road infrastructure does not need to be modified and most of the equipment can sit on the side of the road rather than on gantries.

One challenge with software implementations is that the high

Need to know

USB 3.0 technology enables systems integrators to create better imaging solutions for ITS

- In spring 2014, Lumenera launched a new high-performance USB 3.0 industrial camera based on Sony's EXview HAD II ICX694 CCD sensor
- The Lt665R camera runs at 27fps at full resolution, faster than any other USB 3.0 camera on this sensor
- The camera has been engineered for excellent sensitivity, a high dynamic range with low noise, and reliable delivery of images through advanced frame buffering technology



(Left) It is becoming more common for traffic lights to be accompanied by enforcement cameras

(Right) Lumenera's new industrial camera is built with USB 3.0 technology

frame rate and high resolution required result in a data rate beyond the capabilities of traditional technologies. For example, if an application requires an image with a resolution of 5MP, a bit depth of 14bits and a frame rate of 30fps, one cannot use a camera with a GigE interface since it requires a payload throughput of 2.1Gbps. A camera with a USB 3.0 interface is the right choice as it can handle this higher throughput (5Gbps total throughput with 3.2Gbps effective for payload once the overhead is taken into account), is reliable and cost-effective.

GigE is one of the more popular interfaces for cameras used in traffic applications since it is relatively fast and stable, and requires no expensive

frame grabber cards. The introduction of USB 3.0 in 2008 and the release of products in 2010 created a buzz in the camera community about the potential benefits for cameras using this new interface.

GigE was fairly ubiquitous for cameras as it was mature, is found on most computer platforms, and at 1Gbps could meet the needs of most of the older image sensor technologies. When USB 3.0 was introduced with a throughput of 5Gbps combined with the emergence of affordable high-speed image sensors, this changed the landscape of camera interfaces.

Benefits and possibilities

Before USB 3.0, if you required a camera that could output higher resolution and higher

frame rates than GigE could support, you needed an interface such as CameraLink (medium or full modes), which were more costly and complex, had limited cable length and required a frame grabber card. The requirement for a frame grabber can become a major obstacle for compact embedded platforms, such as those found in transportation.

In 2011, Lumenera recognized that USB 3.0 would change the landscape of camera interfaces by enabling higher resolutions and frame rates without requiring frame grabbers. USB 3.0, like USB 2.0, is a plug-and-play interface, which has grown in popularity and now has strong support on the host side with many hardware platforms and mature drivers. This makes USB 3.0 an ideal solution for applications requiring more than can be offered by GigE and dual GigE interfaces.

A fairly common misconception with USB, is that it is restricted by cable length. Most people might think that 5m is the maximum distance that can be achieved between a USB 3.0 device and host computer. This is simply not true. Many vendors now sell active cabling solutions that permit customers to extend the range between the device and computer by as much as 20m.

An active cable is a simple solution and is nothing more than a regular cable including built-in electronics that are powered directly from a second USB port for a plug-and-play experience. For deployments requiring up to 100m between camera and host computer, there are transcoder solutions over optical cabling that can achieve that distance with the added benefit of providing



electrical isolation in between equipment. In open road deployments that are prone to lightning strikes, the decoupling of the camera and computer via a fiber optic cable and USB extender increases the reliability of the solution.

Beyond higher throughput, there are other advantages to USB 3.0 over USB 2.0 and other interfaces such as the now dwindling FireWire interface. USB 3.0 also provides increased power delivery (900mA versus 400mA for USB 2.0), which can enable many

cameras to operate without requiring a power supply, thus reducing the number of cables connected between the camera and host computer. USB 3.0 offers extremely fast signaling for accurate synchronization of cameras, even in multicamera systems.

USB 3.0 supports Direct Memory Access (DMA), which minimizes CPU usage while transferring large amounts of data to the hard drive. Minimal signal latency with USB 3.0 is another benefit when dealing with the synchronization of cameras and other devices.

Future proof

There are several questions systems integrators must ask when building a quality USB 3.0 host computer solution. Will the computer be able to handle the higher throughput for streaming video or high resolution, and fast frame-rate snapshot modes of high-speed traffic applications such as ALPR? Will there be some sort of post-processing of images after capture? How stable and efficient are the drivers being provided by the camera vendor? How much CPU, RAM, HD space is required? How many

solid state drives will be required for the application? Will I require a RAID configuration for my drives?

These are all valid questions that need to be worked out between the system integrator and the camera vendor. There are so many unique applications that ITS systems are used for, so it is important for road authorities to partner with camera vendors that understand the requirements of their solution, and who can quickly provide expert advice and solve problems as they arise.

A successful ITS deployment involves more than cobbling pieces of equipment and software together; it involves strategic partnerships with companies that will provide the quality and ongoing service level required to produce a high quality and reliable imaging solution.

As ITS requirements evolve, one needs to consider the benefits of USB 3.0 for these applications. Understanding all the benefits of using a quality USB 3.0 solution is the first step to ensuring the right decision is being made for the application in mind.

Lumenera has spent many years developing reliable, high-quality, customized camera solutions with GigE and USB interfaces, and the company believes that the time is right for integrators to adopt USB 3.0 as the new technology that will enable new and more powerful ALPR and other traffic-related applications. ○



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