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White Paper - USB3.0 for Machine Vision?   -   Absolutely!

For the past decade, **Gigabit Ethernet (GigE)** has been the preferred choice as a camera interface for machine vision applications. It started off slowly supplementing **Firewire** (A/400 & B/800) as the then current choice, but picked up steam as it became apparent that Firewire 1600 was not going to gain traction in the marketplace. Today, **USB3.0** is picking up steam and being molded into an excellent choice for machine vision applications.

View all USB3.0 Vision cameras

How is USB3.0 a good choice today?
Let us review the requirements for a machine vision application today!
Machine vision is a subset of the automated imaging domain where you are using cameras to capture data and computers to make intelligent decisions from it. This space includes applications in the medical, defense, mapping, and of course, the industrial market, where machine vision lies. While all these applications use a camera, the requirements of mounting and using a camera on a microscope in a lab differ from that camera being on a robot in an auto factory!

Requirements include:

- Cannot miss any frames
- Relatively high speed data transfer
- Low latency on host CPU
- Ability to use multiple cameras
- Relatively long cable lengths
- Locking connectors at camera and computer

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How did we get here? Let's do a quick recap of the old interfaces

Firewire was a great interface for machine vision applications with its isochronous interface. This means that it had dedicated time slots for both data and control packets within its protocol. For video it guaranteed no missed data, the interface cards had DMA; these and other features meant that it was a great choice at the time.

GigE had a few things going for it. First, it was about 2x faster than Firewire 800. Second, Firewire was limited in its cabling to about 7 meters without going to expensive fiber solutions, where GigE could support 100 meters. Vendors started making cables with screw locks at each end, and it used standard NIC cards that could be gotten anywhere, anytime. Finally, the AIA created a standard for GigE cameras called GigEvision.

USB2 suffered from a few problems for solving machine vision problems. First off, it was limited to about 30ish MB/s of data. Second, cable lengths were very limited. Third, there were not many 'industrial' cables with screw locks. Fourth, there was no standard for machine vision protocol in imaging. Lastly, using the regular Microsoft drivers for imaging performed very poorly for demanding vision applications. Several vendors addressed these issues with their own drivers, and cables, and made robust solutions that solved machine vision applications very well, but these were proprietary, and not industry wide.

Comparison of Interfaces

Features	Firewire400	Firewire800	GigE	USB2	USB3
No missed frames	Yes	Yes	Yes, Packet retry	With Proprietary Driver	Yes
Copper Cable Length	10m	7m	100m	5m	8m
Longer than 10M cable costs	High	High	low	X	low
Screw Lock Connectors	Yes	Yes	Yes	Proprietary	Yes
Multi Camera Systems	Excellent	Excellent	Excellent	Poor	Excellent
Bandwidth	32 MB/S	64 MB/s	110 MB/s	40 MB/s	400 MB/s
CPU Utilization in data transfer	low	low	low w filter driver	high	low
AIA/IEEE Vision Standards	IEEE	IEEE	AIA	None	AIA

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USB3.0 Changes the game!
USB3.0 offers roughly 10x the performance of USB2 and 3.5x the performance of GigE! With all the new CMOS high speed sensors from ON SEMI and Sony just coming out, cameras need a higher speed interface to take advantage of this. Next, the AIA has created a standard for USB3Vision. Unlike USB2 which used program IO to move data, USB3.0 protocols are based on DMA transfers, critical for low CPU latency, even much better than GigE. Finally, cable manufacturers have created industrial cables with screw locks. These are available up to 7 meters, and if you use Active Optical Cables, up to 20 meters. A 20 meter cable is under $150 with screw locks. To go further, optical cables are available at a fraction of the cost that camera link optical cables sold for.

Contact us to discuss how USB3.0 Vision cameras can be adapted to your application!

Want to learn more details on USB3.0? Read this additional White Paper on **"Why it makes sense to switch to USB3.0 now!"** which provides specific details on CPU usage, cable lengths, USB controllers and multi-camera configurations.

USB3.0 for machine vision applications is not only a viable solution, but for high speed applications, it is the only solution!

Additional related resources:

1. **USB3.0 Cameras**
2. **ON-SEMI image sensors and related cameras**
3. **Sony Pregius image sensors and related cameras**
4. **Learn how "Pixel Clock Overdrive" from IDS created the fastest USB3 frame rate cameras using ON-Semiconductor image sensors.**

1st Vision has extensive knowledge in industrial imaging and can help answer any questions. We have over 100 years of combined knowledge and look forward to discussing your application.

Please do not hesitate to **Contact us**! 1st Vision can provide a complete solution including cameras, lenses, lighting and cables.