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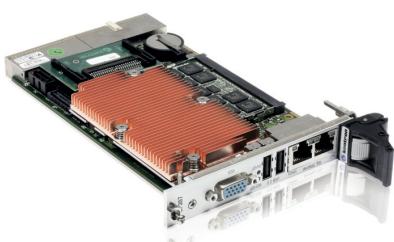
» Application Story «

CompactPCI® in Transportation



Tunnel Safety Requires Sound Performance from Rugged Computers

Automated Video Surveillance of Tunnels Using CompactPCI® Systems by Kontron



Automated video surveillance promises to increase the safety of tunnels used by road traffic and reduce tunnel operating costs at the same time. An Austrian firm named Center Communication Systems (or "Center Systems" for short) won some major new customers within just a few months of launching a new version of its tunnel surveillance package VBTC Tunnel (Video-Based Traffic Control). The application features new algorithms, an improved single-frame method, and an intelligent alert management system. Powerful hardware is an essential prerequisite for running a powerful image-processing application. Since harsh environmental conditions can exist in tunnels, it is not possible to use just any computer for them. In the new systems, CompactPCI® boards made by Kontron are utilized.

Center Communication Systems GmbH based in Vienna is the largest supplier of communications systems employed in the public and private traffic and surveillance field in Austria. It also supplies its customers with radio and data communications systems. Center Systems has become a specialist in a particular area in the last three years, namely automated video surveillance in tunnels. The firm developed its VBTC Tunnel video surveillance system in only a year. The system analyzes single video frames. To do this, it uses existing basic algorithms for recognizing video images, which have been specially optimized for monitoring tunnels used by road traffic, as well as a newly developed automated alert system that independently interprets and filters the conditions it has automatically detected. As a result, it reports only events that are relevant as alerts, which reduces the amount of work to be handled at the control center.



Figure 1: The VDEC units in the control room.

Single-frame Methods and Algorithms

A modular system based on CompactPCI® technology, VBTC Tunnel is capable of recognizing different categories of vehicles, speeds of vehicles, and distances between vehicles in addition to critical situations such as pedestrians in the tunnel, smoke, fog, cars driving on the wrong side of the road, freight dropped by vehicles, and breakdowns on the hard shoulder, all of which is done by analyzing sequences of digital image data. It is also able to measure traffic density and the flow of traffic. This makes it possible for forecasts to be made about traffic that enable potential traffic jams to be avoided in tunnels thanks to intelligent traffic control. Due to new basic algorithms, which call for high computing power, the system can filter out error sources that used to occur in earlier video surveillance systems for tunnels. As a result, the system even recognizes flashing blue lights, mud

on lanes, mist, or dust, which all triggered off unnecessary warnings in earlier systems, as they were interpreted as smoke, fire, or lost cargo. In the past, these false alarms put control center personnel under unnecessary pressure and weakened the level of acceptance that automated video surveillance enjoyed. Using CompactPCI® systems equipped with multicore CompactPCI® boards from Kontron, an unprecedentedly high degree of precision can be achieved in detection today: 99.9 percent at locations fitted with dual cameras, with a false negative value of just 0.001 percent. In other words, the system misassigns only one incident in a thousand, which leads to a false alarm being triggered. The likelihood that a situation that really is hazardous will fail to be recognized as such is merely one in 100,000. All of the modules running in the system detect incidents occurring within milliseconds and immediately report genuine faults to the control center by means of visual and acoustic warning signals.



Figure 2: The system recognizes irregularities immediately even in unfavorable light conditions

Alert Management System

Unlike older systems, VBTC Tunnel will only report a vehicle that is moving in the wrong direction once due to its built-in alert management system, even though several cameras will detect the occurrence. This way, unnecessary redundant warnings are avoided at the control center even if each of the additional cameras recognizes the same driver again just a few feet further on. The system is considerably safer as a result. The work the monitoring staff has to do is greatly reduced, especially on occasions when every second counts. And yet the integrated alert management system does not have to remain wholly passive. In the event of an alert, it can actively control light signaling systems, change predefined switching cycles adapted to the traffic flow, or even request help from external rescue services, all within just five seconds. The special video surveillance system for tunnels is capable of operating independently and controlling working processes itself to a very large extent. Tunnel operators employ these functions to monitor long tunnels, or even several small tunnels, via a single control center, which significantly reduces their operating

costs while maintaining the same level of safety — or even enhancing it. The video image detection units have been produced as individual software modules so that customers can pick the ones they require from various packages, depending on the size and length of the tunnel in question, the volume of traffic, and the weather conditions specific to the country or region. Upgrades are possible anytime, making the entire video surveillance system scalable and future-proof.

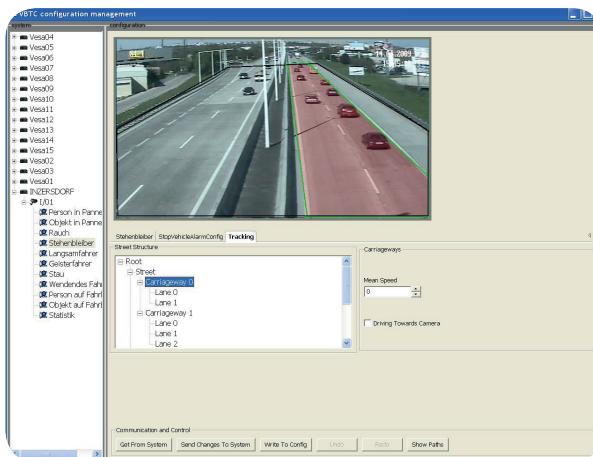


Figure 3: Video images are detected by means of software modules combined in line with customers' specific needs

Structure of the System

In each of the tunnels to be monitored, up to eight analog cameras — which are superior to digital technology because of their greater sensitivity to light — can be connected to CompactPCI®-based VESA units (Video Encoding Storage Analysis) via coaxial cable or optical waveguides. The video signal from each camera is recorded on these units. The system stores the streams in a compressed form in a self-overwriting circular buffer for up to thirty days, depending on what period has been set, along with the time, date, and location, thus enabling the data to be used in a court of justice if necessary. If a hard drive ever happens to fail, none of the image data is lost thanks to the RAID-5 or RAID-10 technology employed. The VESA units, which feature a Kontron CP307 assembly functioning as the main CPU, process enormous amounts of data, analyze the video images in real time, and control the alert management system as well.

"The new algorithms used for pattern recognition and the improved recognition of individual images required high-performance computers to be used," explains Johannes Traxler, head of Image Processing at Center Communication Systems. "Since the systems aren't kept in warm observation areas, but in tunnels, the ruggedness and long service life of the hardware were of prime importance to us, not just system reliability. The VESA units operate in harsh conditions round the clock seven days a week. As well as being fanless, the industrial PCs need to be resistant to dust, soot, humidity, gases, and salts, and cope with large fluctuations in temperature. That's why we've

put our faith in rugged, high-availability industrial hardware made to CompactPCI® standard."

Equipped with redundant hot-swappable power supply units, the 19" systems also have an adapted backplane designed in conjunction with Kontron so that PCI-based frame grabbers could be incorporated into the CompactPCI®-based systems via a CompactPCI®-to-PCI converter. "Besides using standardized industrial hardware with a long service life, we employ PCI-based components for digitizing the video signals, because this is a market subject to considerable short-term change. Aside from this, it gives us more flexibility when incorporating customer-specific cameras, which makes it much easier to work in existing installations. So the hybrid nature of the system is ideal. We're very pleased that Kontron is flexible in this respect and has some attractive solutions to offer despite such special configurations," says Johannes Traxler.



Figure 4: How VBTC Tunnel's VESA units are constructed, from left to right: PCI-based frame grabber cards, a RAID controller, a Kontron CP307 CPU board, four hard-drive slots, and two power supply units

Reporting to the Control System

The transfer of data to the control system, which is kept at a low level by processing and storing incidents in a decentralized fashion, takes place over Ethernet in line with IEC 60870-5-104, the standard for telecontrol tasks in IP networks. In addition to this, the system also supports other standards that make Web-based applications possible, such as the XML MoRis protocol. Only one physical LAN is necessary in the entire tunnel, and this can be expanded redundantly if required. One or more video decoding (VDEC) units are employed at the control center for visualizing the data. Up to eight monitors in full-frame PAL format may be connected, thus displaying 200 full frames per second in full D1 format. Center Systems uses Kontron's CP307 assembly for this purpose, as it does in the decentralized VESA units, but without any hard drives mounted on the board. Each VDEC unit can switch to each of the decentralized cameras. When doing this, it accesses the VESA unit's video buffer in real time. Besides monitoring the current situation, it is also possible to retrieve data from the whole video memory. In the case of deferred monitoring, the features available then include fast forwarding and rewinding,

slow motion, single-frame control, and jumping to specific time marks or timeline overviews.

VBTC Tunnel is platform-independent, and is shipped by Center Systems with Linux as the standard OS. Other user interfaces for UNIX or Microsoft Windows® are also available, so the system can easily be integrated into any control center environment. The comprehensive software support provided for the tunnel surveillance system makes special demands on the company's hardware supplier, however: using Open Source, and particularly Linux, means the vendor constantly has to adapt its products to the latest developments. Kontron has consequently set up some Linux distributors of its own, and is also very active in this area. ThinkIO, Kontron's DIN rail-mounted PC, is an example of this. Further distributors are currently being evaluated.



Figure 5: Due to the high computing power of Kontron's CompactPCI boards, the detection system can achieve extremely high precision in a very short response time

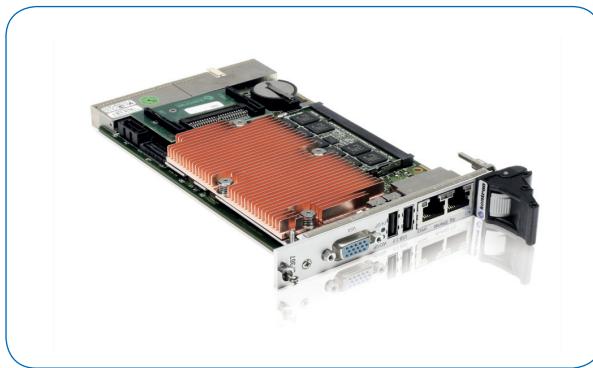


Figure 6: Kontron's CP307, the key element of the VESA and VDEC units

Prospects for the Future

Center Systems, whose tunnel communications systems are already being employed in 100 tunnels in Europe, won seven new tunnel operators as customers for its new VBTC Tunnel system immediately after completing the initial sales phase, and demand is increasing with every additional installation. Nevertheless, the firm doesn't intend to keep working with the current state of its technology: "We want to enhance the system even further. Various improvements are going to be made in the future, like recognition of situations across the whole system (intelligent alert management), and additional algorithms for detecting object classes even more precisely in the TLS. To be able to do these things, however, we'll need more powerful computer technology that's also extremely robust and designed without fans. This doesn't exist yet, though, because the very latest high-end performance always means a comparatively high loss of power, and therefore active cooling. From that point of view, we only rely on the latest developments made for fanless CompactPCI® boards, as what's possible in these systems always represents the best performance possible in units with an extremely robust structure. We can clearly see what's actually possible in the products Kontron is now presenting, for Kontron frequently promotes matching boards at the same time as it launches its latest embedded processors. We can work on implementing the latest processor technology within a very short time this way, because we also need to get our innovations on the market as quickly as possible to be able to offer our customers the latest technology extremely quickly. At the end of the day, that's what reduces their investment and operating costs."

Traxler felt the developments regarding rugged MicroTCA were also of considerable interest. CCS will have to wait a while before it can start evaluating this new technology, though. "Currently, MicroTCA is still too expensive and too new. That's why we're continuing to use the trusted CompactPCI® standard. Still, we do welcome developments concerning switched-fabric backplanes with high-speed serial interconnects. We'll definitely be keeping an eye on this topic in the future. It's a good thing Kontron's playing an active role in all the platforms of relevance to us. We can find everything we need here — from VME and CompactPCI® to rugged MicroTCA. What's more, Kontron acts as a valuable advisor whenever we need to choose a suitable system platform in view of the myriad possibilities that exist in embedded computer technology. I don't know of any comparable manufacturer of embedded computer technology as yet."

About Kontron

Kontron is a global leader in embedded computing technology. With more than 40% of its employees in research and development, Kontron creates many of the standards that drive the world's embedded computing platforms. Kontron's product longevity, local engineering and support, and value-added services, helps create a sustainable and viable embedded solution for OEMs and system integrators.

Kontron works closely with its customers on their embedded application-ready platforms and custom solutions, enabling them to focus on their core competencies. The result is an accelerated time-to-market, reduced total-cost-of-ownership and an improved overall application with leading-edge, highly-reliable embedded technology.

Kontron is listed on the German TecDAX stock exchanges under the symbol "KBC". For more information, please visit: www.kontron.com

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