Snapshot of the action

Industrial cameras offer enhanced imaging performance and specialised features to help rise to the unique set of challenges found within the transportation industry

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Transportation infrastructures incorporate an amazing amount of imaging technology, which can be found in the sophisticated equipment working silently along our roads and highways. Imaging technology has become an integral component of intelligent transportation systems (ITS), serving as an extra set of eyes on the road, improving our safety and contributing to a problem-free and pleasant driving experience.

ITS is a constantly evolving sector and one recent trend is the increased use of machine vision cameras. ITS systems use advanced technologies such as computers, sensors (including vision sensors), control, communications and electronic devices to improve the safety, efficiency and capacity of a transportation system. When integrated into the system's infrastructure, these technologies relieve congestion, improve safety and enhance efficiency and productivity. Vision technology plays a key role within such systems.

Vision systems are being used in a variety of ITS applications, such as: traffic signal control; automated tolling; safety monitoring; speed and red light enforcement; reserved lane enforcement; parking access; tunnel safety; and road inspection. Each application presents a challenging set of requirements for vision systems and automated imaging. For example, free-flow toll systems require real-time cameras to capture the high speeds of the vehicles, as well as high-resolution and high-sensitivity sensors. For speed enforcement, numberplate recognition is a demanding application that must contend with varying formats in plate and character styles as well as issues of dirt, dents, high speeds and variations in lighting. For tunnel systems, effective incident management depends on fast incident detection and verification, relying on the ability of the vision system to quickly narrow the flow of information to the most relevant data. Overall, most transportation systems must deal with uncontrolled lighting, harsh environments and competing priorities.

The issue of lighting

Ambient lighting is often very difficult or impossible to eliminate and can rarely be ignored, setting transportation apart from industrial vision applications. To compound the problem, providing enough additional light to uniformly illuminate vehicles so an image can be captured accurately using an area-scan camera can be highly challenging. Rather than eliminate the ambient light, then, it must be effectively managed by the vision system, including the dramatic variations that occur during the course of a day.

There are also a number of environmental concerns that must be addressed. In transportation applications, vision systems must be designed for conditions that might include extreme temperatures and humidity, as well as blowing leaves and debris. With systems being implemented worldwide, conditions can vary from frigid cold to torrid heat, fine dust from the desert to freezing rain from the northern climates. In all cases, shock and vibrations from passing vehicles are constant and must be dealt with using extremely robust equipment.

Cameras for transportation need to be very rugged and reliable. In transportation, image-processing systems are often installed in remote locations. This may make access very difficult, due to height and safety regulations. The cost of replacing or fixing unreliable equipment is prohibitive without even counting the disruption and the environmental costs associated with such repairs, further stressing the need for quality, robust and proven products to be specified.

The selection of the correct camera is essential to the performance of the complete transportation system. Several factors play a role when selecting the sensors for ITS. The first is the resolution of the sensor; it determines the ease of identifying details from a given portion of the image. If, as with toll collection systems and speed measurement devices, only the numberplates for individual vehicles or the flow of traffic into a tunnel must be recorded,

Road tunnels are a challenging application area for camera-based solutions

then a relatively low resolution is sufficient. If, however, a toll collection system or a traffic violation monitoring system must record several lanes of traffic at once, then a high-resolution sensor with a high pixel count would be required.

If the cameras are running in high-resolution mode all the time, there is a large amount of data and most of it will not be relevant. Certain functionality can be added to the camera to reduce wasted data to minimise the overload to the host computer. One example is for the camera to operate in one or many regions of interest (ROI), with just a small portion of the scene being transmitted.

Designed for the traffic market

Industrial cameras have become a proven solution to the challenging set of requirements for vision systems and automated imaging. In turn, machine vision vendors offer a wide range of cameras specifically designed for advanced transportation systems. Industrial cameras offer enhanced imaging performance, and a robust, compact enclosure suitable for the demanding environments found within the transportation industry. These cameras rely on specialised image sensors to deliver higher dynamic range, onboard memory buffering, better sensitivity and also to capture excellent quality, high-speed images with zero blur – solving the motion artefact limitation found with traditional camera sensors. All of these camera features combined with a choice of Gigabit Ethernet, USB 2.0 or USB 3.0 data interfaces are ideal for traffic and transportation applications. Some applications might be so unique that no off-the-shelf cameras can fully satisfy the application requirements. In such cases, a custom-designed camera might be the better choice.

Many of us as drivers are unaware of the benefits that are obtained through the integration of imaging technology into ITS systems. These systems are working hard in the background, delivering invaluable information to us (such as accidents ahead or travel delays), quickly resolving any traffic disturbances as they arise, and most importantly, improving our safety. ■