Information on Screen: Video Surveillance in Industrial Automation

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Seeing is believing, according to the old saying. That explains some of the advantages video surveillance has to offer for industrial automation. With cameras and the right technology, operators and engineers can survey a scene in a remote or dangerous area safely. Also, they can be in many places at once, seeing with their own eyes what is happening without risking those eyes – or other body parts.

The challenge, however, is how to see intelligently. Staring at a screen is not the answer, since in such a setting it's all too easy to lose focus and miss an important event.

Fortunately, advances in digital video compression and other technologies have made the job easier. They provide a way to combine what the camera sees with other data, presenting information in real time so that a more intelligent decision can be made. They also allow tracking video to be synchronized with alarm logs and stored for later analysis.

Video surveillance for industrial automation:

- Increases safety
- Improves productivity
- Cuts response time
- Enables more intelligent decisions
- Enhances record keeping

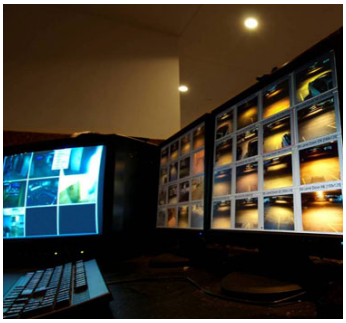
This white paper will discuss the technology behind the improvements in video surveillance and how these can benefit industrial automation. Some example applications and products will be covered, as well.

A surveillance disconnect

Traditionally, video surveillance was something done for security. Cameras mounted at strategic points captured what was going on. Any real-time monitoring was done by a guard sitting at a

desk, often by looking at a bank of screens. The cameras were analog affairs, with the data stored on tape. The advent of digital cameras and video technologies provided some improvements and enhancements but did little to fundamentally change this scenario.

For industrial automation applications, there's a lot wrong with this picture. For one thing, studies by Sandia National Laboratories have shown that people can only concentrate on a target for a limited amount of time. After 10 to 20 minutes, their attention wanders and crucial details are lost.



A related problem is that people who are concentrating are good at tuning out parts of a scene, thereby missing the unexpected. In a demonstration about how the visual system works, Purdue University researchers have members in an audience watch a film. The instructions given to the audience are to count how many basketball passes are done by a group of people wearing white shirts, with this team moving among a group wearing black shirts. Those audience members who follow directives faithfully will completely miss it when someone in a gorilla suit strolls through the scene.

As these studies show, video surveillance using people as the primary means to evaluate a real-time feed can be worse than not having anyone examine the video at all. Most of the time the video will show a benign scene, with everything as expected. There may be long stretches of time where little of importance happens. In these circumstances, the ability of a watcher to spot the unusual will be diminished due to a natural lack of concentration, as well as the normal tendency to follow activities that are known to be of critical importance and ignore others.
Industrial automation applications can involve dangerous situations or circumstances where the wrong decision can be very costly. Consequently, what's needed for these uses is some way to improve video monitoring.

That is difficult to do with traditional technology and methods. For one thing, typical surveillance only provides a visual view because that is what is important for security. Other information, such as temperature or pressure in a tank, is not. So this data is not on the screen and not synchronized to the feed. This video only orientation can be a severe handicap, given all the data that industrial transmitters and controllers can generate.

What's more, conventional systems can only play back that video by time and date. Such information as logs or alarms cannot be used to find a particular image or sequence of images, as there is no direct link between the two. It is possible, clearly, to use time-stamps to achieve this linkage, but a manual operation to do this can be tedious and error-prone.

A final hurdle built into the standard approach is that security vendors are not the ones involved in industrial automation. Thus, their products can only be integrated into control systems, and vice versa, with difficulty. Even if done successfully, the result is typically only On/Off recording control and nothing more. Things like the integration of alarm summary tracking and listing with the video feed is usually not feasible.

Watching a furnace safely

These problems keep industrial automation applications from realizing some significant benefits. Consider a few scenarios where video surveillance could be helpful.

The first involves hazardous applications, such as an area with some combination of a boiler, furnace, compressor, and gas piping. Another somewhat similar setting might involve a gas or chemical storage tank. Keeping operators, technicians, and engineers out of these locations is a good practice, since it minimizes their exposure to what could be a life threatening situation. At the same time, however, seeing what's going on inside these areas can help with

scheduled maintenance and in diagnosing unscheduled shutdowns or other problems. If a high pressure alarm sounds, for example, an operator could use video surveillance to check on the situation, with the images providing another means in addition to the data from sensors to assess what is happening.

Thus, being able to see at a safe distance could be very helpful in what are fairly common industrial circumstances. Not only can it increase safety but it can also help maximize uptime.
A second broad industrial category where video surveillance could prove useful involves environmental monitoring. People already do this in their private life when, for example, they use a remote camera feed to scout out the weather at a resort before setting off on a vacation. In an industrial application, an analogous situation could involve river monitoring during a hurricane or a similar heavy-rain weather event. During those times, being able to see the level of rivers or levees can be very informative. It can help in such tasks as deciding when to open flood gates, shut down pumps, evacuate personnel, or take other action.

Again, safety is one benefit. In this case, however, the people made safer can involve those along the riverbanks and elsewhere as well as plant personnel.

In both of these examples, video surveillance also means that plant staff can effectively be in many places at once. By using cameras, they can visually scan a number of locations quite quickly. Thus, the technology boosts productivity.

Video for less

As these examples show, video surveillance can bring some important benefits. Now, thanks to technical improvements, those benefits – and much more – are easier to achieve in an industrial automation setting.

The first technology advance is deployment of video compression technology built to meet the MPEG-4 and H.264 standard. Developed by the Moving Picture Experts Group – hence the letters in MPEG-4 – and others, these standards specify how video is to be compressed, allowing a 720 by 480 30 frame per second image to be transmitted at bit rates that range from a few tens of kilobits up to several megabits per second. Much of that bandwidth range is well below the capacity of landline broadband or 3G wireless networks. That makes it possible to deliver relatively high quality video to laptops, handheld devices, mobile terminals, and elsewhere.

The second technological enhancement involves IP, or Internet protocol, addressable cameras. Better and cheaper sensors, along with less expensive electronics and optics, have made these cameras inexpensive while still allowing them to produce relatively high quality video. These cameras can also be accessed and controlled using standard IP addresses and technology, a capability that enables networked video surveillance.

The cameras and the surveillance they make possible have proven popular, as a look at market statistics illustrates. According to the UK-based business and technology consultancy IMS Research, the market for network video surveillance will grow by nearly a third this year, despite the global slowdown. The projected 29 percent increase for this category compares to a tenth that, or 3 percent, for the analog surveillance market.

The growth of the traditional market is expected to remain low, while the growth rate for network video surveillance is expected to pick up. Estimates are that the compound annual growth rate will be about 38 percent, with the market value hitting $4 billion U.S. by 2011.
In another indication of that growth, consider what will happen to the video. The data generated will hit 3.3 exabytes, or 3.3 billion gigabytes, by 2012 and will consume $750 million worth of external storage by that year, according to IMS.

Augmenting industrial automation

For industrial automation applications, what does this new technology mean? It provides a way to marry video with other data in a manner that offers multiple benefits. These include increased safety, greater productivity, and the ability to respond quicker and more intelligently to an unusual situation or crisis. There are also potential gains in improved record keeping and incident post-mortems.

All of these benefits are possible because the video feed from the new breed of cameras is digital in nature. Since bits are bits, the video data is no different from the data streaming in from sensors and controllers that sit on the network. Either data set can be carried anywhere by an IP compatible protocol, with all of the data subject to processing and display by a handheld device, laptop, or suitable computer.

For industrial settings, this means that IO data can be displayed on the screen, along with the visual data. What that is done, operators and engineers no longer have to monitor two systems. Instead they only need follow one.

The information content can be defined such that only the most important aspects are displayed. The size, color, and position of this content can be set up as needed. What appears can be more than a static array of numbers or a simple view from a camera. Action items that need attention can flash or change color if, for example, an alarm happens.

In some ways, this is similar to what is done in augmented reality. Long a staple of movies and academic research, this technology is moving into the mainstream. The basic idea is bring together disparate information streams, overlaying data on scene. This additional information can then be used to make a better, more informed decision.

The key is not simply that information is displayed. Rather, it is that the data is filtered and the important elements are highlighted, thereby quickly allowing the viewer to focus in on what is critical while ignoring what is not. At the same time, additional data is available if the viewer wants to drill deeper or investigate something unusual.

In such an arrangement, one essential ingredient is the ability to quickly and successfully filter the vital from the trivial. In the type of free-flowing situation depicted in the movies and researched at universities, this filtering can be a challenging task to do properly, requiring tremendous amounts of computing power and very sophisticated algorithms.

An industrial automation application, on the other hand, is a much more constrained setting. The important parameters are known, along with the values of those readings which should cause an alarm. Because of this, today's technology is up to the task.

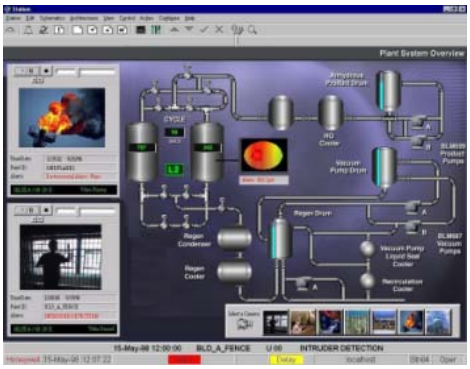
Benefits and examples

To see how video surveillance can be used in industrial automation, consider the following scenarios. All are fairly standard industrial situations.

Plants often have to clean their waste air discharge of pollutants or contaminants for regulatory, safety or other reasons. While this can be done in a number of ways, one method that is used involves a flare. The flame consumes the pollutants and transforms them into something more environmentally friendly. Alternatively, if the contaminant is explosive, a controlled burn can eliminate it from the waste stream, which increases safety.

In the case of a flare, information about the concentrations of oxides of nitrogen and sulfur generated by the combustion can be superimposed on the scene, along with the temperature of the flare. Like the video itself, all of this information can be real-time. With this setup, an operator or engineer would be able to see the flame and all pertinent data about it at the same time.

For a chemical tank, the typical video conveys little information of importance, since it often is just an image of the outside of the tank. However, with the new technology the situation can be significantly improved. The level of the liquid inside the tank and its temperature can show up on an image of the facility, with both being updated constantly.



Another automation application can be found in moving goods into and out of a factory, a very common industrial operation. With the right hardware and software, a video image of a truck entering a site can be displayed, along with its license plate number and weight. The plate number can be extracted using pattern recognition and a camera while the weight can come from a scale. This integration of video with other data can be particularly helpful during an alarm situation, since operators and engineers need only scan one screen to get all the important, relevant information. This data linkage also means that the video data, alarms and logs are synchronized. Thus, the entire stream can be searched, which could prove important when events are analyzed later.
To get all of these benefits when an industrial automation video surveillance solution is implemented, it is important to pick a provider that has expertise in both areas. Advantech, for example, has a strong automation portfolio and extensive experience in digital video solutions. The company's industrial video surveillance products include software and video capture cards for PCI, PCI-104 and USB IO. Many offer hardware compression on the card, which reduces the load on the host. There also are PCI boards with software compression, suitable for those situations when enough processing power is available and dedicated hardware is not needed.

Conclusion

To recap, technological advances mean that video surveillance solutions can now bring substantial benefits to industrial settings. Safety can be improved, with plant personnel able to monitor dangerous operations remotely. This also can increase productivity, since staff can use

surveillance to keep an eye on many different locations at the same time.

But, because of digital technology, the benefits are greater than that. Industrially relevant information – like pressure, temperature, or fluid level – can be superimposed on the image. This makes video surveillance more useful and improves the ability to make the correct decision during an incident. Combining information in this manner also makes recorded video more meaningful, since it can now be linked to alarms and log listings of measured parameters.

Finally, when selecting a solution, choosing the right vendor is critical. One that has experience in both fields, like Advantech does, is important. Only then can a solution be crafted that best meets the particular needs of an industrial automation application.

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