BACKGROUNDER

multisensor detection

a life safety white paper

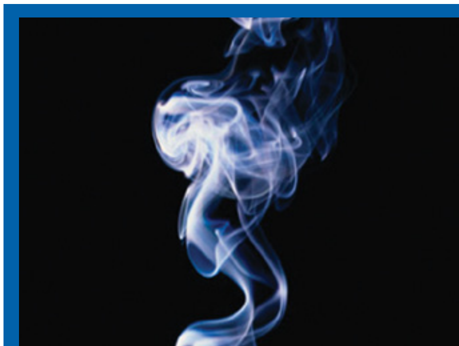
The airport terminal was a hive of activity when the evacuation message was suddenly broadcast over the life safety audio system. Thousands of anxious travelers were herded to the exits as staff and security personnel tried their best to reassure the crowds that they'd reach their destinations and their connecting flights despite the fact that the terminal would have to be emptied. Tempers flared. Flights were missed. And a good deal of money was lost. No one was injured in the fire, and only minimal property damaged resulted. But the costs were both real – and avoidable.

The fire started in a maintenance room on the departures level. But because the initial flames were fed by cleaning fluid, they produced little smoke. The smoke detector just outside the room failed to respond until the fire had spread into the walls. Even then, airport staff, harassed by a series of false alarms in the weeks leading up to the incident, were slow to react. It wasn't until emergency response personnel arrived on the scene that the fire was discovered. But by then the terminal had already filled with smoke.

This story, though hypothetical, illustrates just how fragile the integrity of a fire alarm system can be and just how serious the outcome can get. False alarms and the unpredictable nature of fires make a dangerous combination. But advances in technology have cleared the way for new products and approaches that would make it virtually impossible for this airport's system to fail.

Sharing the processing burden

In recent years, designers and manufacturers of fire alarm systems have pushed beyond conventional technologies into the realm of distributed intelligence. Like most revolutionary ideas, distributed intelligence rests on a deceptively simple premise: spread the computing power of a life safety system among its devices, free the control panel from intensive yet mundane processing tasks; and, decentralize the system's core processing functions.



Advanced devices compare values received from on-board sensors to a pre-set algorithm that profiles environmental conditions.

In itself, distributed intelligence is nothing new. The Internet was originally conceived of, decades ago, as a means of providing a kind of command and control system that would support military communications in the event of war. On a smaller scale, modern fire alarm systems provide much the same fail-safe backup that enable them to continue to provide basic life safety functions, even if a control panel or network node is knocked out of action.

What is new is the capacity of today's intelligent life safety devices to do much more than simply send information to the control panel. As a result, the burden of processing data and making decisions has shifted from the control panel to its connected devices and this means there is less data required to make the journey back and forth. By being economical with data, panels today are more efficient and quicker to respond than ever before. And because there is less data traffic, the need for costly high-capacity communications wiring has become a thing of the past. In fact, Signature Series fire detection devices from Edwards can be installed on existing wiring. This cuts retrofit costs by about a third, while at the same time delivering all the advantages of multisensor technology and distributed intelligence.

The need for reliability

Intelligent detection systems monitor their surroundings and adjust themselves to compensate for naturally-occurring environmental conditions. In other words, they know the difference between smoke and something that may look like smoke.

The driving force behind this development has been the need for a design that is more reliable and less susceptible to nuisance alarms. This has been accomplished through modifications to the way information is processed, rather than to the way it is gathered. Even though tremendous gains in detector reliability have been made over the past few years, the basic principles of detection have remained virtually unchanged. Ion, photo, and heat sensors – the

Microprocessor-based intelligence has knocked the perennial bugs out of today's life safety systems. But can any fire detection be reliable under all conditions? The answer is yes.

mainstays of any fire alarm system – still have their own specific applications for which they are best suited.

Because of the unpredictable nature of fire, manufacturers have found it necessary to modify detectors so they perform reasonably well under a wide range of conditions. For example, a photoelectric detector must also be able to respond to a fast flaming fire. The result is a device that operates reasonably well, but not optimally.

The trade-off has come at a price, and nuisance alarms used to be an expected inconvenience. The problem stems from the fact that detectors that are sensitive to smoke are also sensitive to dust; those sensitive to heat can also be affected by normal fluctuations in ambient temperature.

Edwards pioneered the means of overcoming this problem. With the introduction of the Signature Series family of analog fire detectors, sliding alarm thresholds became possible for the first time. This enabled the device to monitor its own sensitivity and "understand" its environment. If dust or humidity levels increase the chance of a false alarm, the device itself is able to compensate automatically by raising its own alarm threshold. There is no danger, however, that the threshold will be pushed so far as to compromise the device's ability to detect fire: before that point is reached, the device sends out a message that it's time for a cleaning.

Signature Series on-board microprocessors have provided a means of addressing another concern: the perennial problem of choosing the best type of detector for a particular application. Signature Series multisensor detectors incorporate photo, ion and heat sensors into a single unit. Independently, these different types of sensors can come up with conflicting conclusions concerning the same environmental conditions. But when they are combined in a single smart detector they can be monitored over time, thus reducing the chance of the device reacting to the wrong set of circumstances.

And that's where the sophistication of the Signature Series detectors comes into play. These advanced devices com-

Principles of detection

Like a pyramid, multisensor detection rises from three cornerstones of sensor technology, plus a forth: time...

Photoelectric
Photoelectric detectors react to medium and large particles – from 0.05 to 10,000 microns – the type of smoke typical of a slow, smoldering fire. These detectors operate by projecting a light source into a sensing chamber. A light receiver is positioned at some angle relative to the light source. If smoke is present in the chamber, light is reflected and refracted by smoke onto the receiver to produce a signal. The first such devices used miniature energy-hogging incandescent light bulbs that had to be replaced frequently. Advances since then have provided a much more efficient light source.

Ionization
Ionization detectors react to a range of much smaller particles – from 0.001 to 2 microns – which are characteristic of gases and fast flaming fires. These detectors work by means of an electrical current instead of light. Inside the detector, two plates are separated by an air gap. The movement of the charged ions towards their respective plates creates a small current flow. Smoke particles entering the chamber of an ionization smoke detector interfere with and reduce this current flow by attaching to ions, thereby increasing their mass and slowing them down so they have trouble reaching the plate. In the early days of ionization smoke detector technology, the strength of the radioactive isotope used was great enough to be of some concern. But current technology uses negligible amounts of isotope today.

Thermal
Heat detectors also play an important role in fire detection. In a case where there may be more flame than smoke, as in an alcohol fire, it's the heat detector that provides the best protection. Heat detectors use neither ionization nor photoelectric detection principles, but instead employ various techniques from solid-state to bi-metal contacts to indicate the presence of heat when the temperature has exceeded a specific value or rate-of-rise.

pare values received from the on-board independent sensors to a pre-set algorithm that profiles environmental conditions. The device's microprocessor can then determine whether there is an actual danger, or whether one of the sensors is reacting to a non-threatening environmental condition such as dust or humidity. This data filtering process means the detector will only initiate an alarm when conditions exactly match the characteristics of a fire.

Benchmarks define the signature of fires

If conditions exceed these benchmarks, an alarm condition results. Meanwhile, false alarms are virtually eliminated because the microprocessor considers several environmental conditions before an alarm is generated. This, however, is generally true only of Signature Series intelligent detectors, which assess the data from all the sensing elements. Multisensor detectors that don't do this are really nothing more than separate sensors that share the same housing.

True multisensor detectors offer a clear advantage over single-application detectors. But since this type of system essentially comprises three different types of detector, is the cost prohibitive? It would be if we were still in the early stages of this technology, but fortunately, the field has moved on. What once would have been a cumbersome, expensive proposition, has emerged as an efficient, versatile, and cost-effective solution to life-safety needs.

Signature Series detectors also adjust their alarm thresholds to compensate for environmental conditions that could generate a false alarm. They don't simply see things in black and white. As true analog devices, they adjust for subtle changes in humidity, air pressure, temperature, and even dirt. They even perform their own sensitivity tests and track important details such as alarm history, number and types of internal troubles, date of manufacture, and the date it was last cleaned. These detectors also indicate where the device is connected in the building wiring relative to the control panel and other smoke detectors. All this information is used to head-off problems before they occur and ensure all the detectors are working at peak efficiency 100 per cent of the time.

Putting all these elements together – the microprocessor plus the latest photoelectric, ionization and thermal sensing techniques – results in multi-sensing capacity that represents technology at its best: reliable, cost-efficient and completely unobtrusive. Had an intelligent system supporting multisensor detectors been installed in the terminal described earlier, the building probably wouldn't have had to be evacuated. The detector would have caught the situation before the fire spread. And because the system would have virtually eliminated false alarms, airport staff would have been more attentive and quicker to react. The fire would have been put out with all but a few building occupants even being aware that there was a problem at all.

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