Is there an alternative technology better equipped than UV or IR to reliably detect a flame?

Flame detection

What is a flame? Remarkably, a not so commonly asked question when looking for a fire.

The fundamental interpretation of a flame is that the carbon particles, most frequently referred to as soot, when heated by the exothermic energy created during oxidation of the fuel; incandesce or in simpler terms, glow white.

As they cool the colour of these particles turn to orange then red and then finally to black as smoke. This is how humans interpret a flame visually and hence recognise it as fire.

With the advancement, of now commonplace, charge coupled device (CCD) technology, digital cameras, mobile phones, and so on, this tool can now be used to accomplish a number of new functions, one being the detection of fire.

Image capture from a CCD pixel array is possible via the photoelectric effect, where light energy is produced by the flame's incandescence. Photons are emitted from the flame then received by the pixels of the array, creating a picture of the flame. The photoelectric effect transforms the energy intensity from the photons into a proportional electrical charge.

UK-based fire detection specialists Micropack produces the FDS300 and FDS301 flame detectors, which have the ability to analyse the array output and similarly as the brain would. The equipment interprets images visually and confirms whether or not a fire is present. The FDS300 and FDS301 can make this decision and output the appropriate alarm condition.

The video is constantly monitored at 25 frames per second (this speed causes persistence of vision which is faster than the human eye) seeking out flame characteristics.

Light emission from the flame is viewed by the CCD array in the near IR. Flames appear in the picture as very bright objects against the background and this feature allows the FDS300 and FDS301 to discriminate against other radiant sources.

Firmware

Flames also have specific incidence, patterns and flicker that are recognisable. Through the use of digital signal programming, software algorithms hand written to an on-board processor of the FDS300 and the FDS301 can establish if the video the firmware is scrutinising has flame characteristics.

Live colour video

A feature that is specific to the FDS301 is the ability to output a continuous live video signal from the device showing the exact 90° field of view that the detector is scrutinising for flame detection. This can be invaluable in emergency situations for assisting control room personnel in directing emergency personnel or evacuees from an urgent situation. The FDS301 also has on board flash video recording of alarms via an internal Secure Digital (SD) memory card. This provides vital data for any incident investigation.

Optical bench

The FDS300 has an optical bench made up of numerous compensating lenses to achieve a 110° horizontal field of view and an 80° vertical field of view alongside the FDS301, which achieves a 90° horizontal and 65° vertical field of view. These compensating lenses further ensure detection can be achieved right to the edge of the flame detection range.

Sensitivity

Due to the unique technique

FD5301 visual flare detector and F5301 flare simulator

that visual flame detection employs to verify flame, a further attribute is that it is not desensitised by typical flame detection inhibitors. The device has one sensitivity setting that is fixed for different fuel types which are to industry standard fire sizes. The most celebrated industry standard is for a $0.1m^2$ n-heptane fire, which the FDS300 can detect from 60m alongside the FDS301 which can detect it from 44m.

It is a common misconception that all flame detection technologies suffer desensitisation in the presence of direct sunlight or blackbody radiation (hot plant process), to name but a few. These attenuators are often stated in the manuals of the flame detectors that are affected by such inhibitors. The FDS visual flame detection product range is not.

Origins

Visual flame detection was developed out of a necessity to detect fires on-board offshore oil and gas installations yet did not react to sources of spurious alarms that are responsible for expensive production losses. Since then visual flame detection has become commonplace across the planet in environments and facilities that cannot afford these false alarm situations.

The motive for advancement toward visual flame technology was because previous flame detection was achieved fairly primitively by measuring radiation of specific UV and IR wavelengths that are emitted from fires. Production losses arising from the frailties that these early detection technologies suffered can now be eradicated. False alarms from blackbody radiation, process relief flare reflections, hot CO_2 emissions, as well as desensitisation from all number of sources, can be laid to rest with the realisation of visual flame detection.

Having a reliable flame detector that is immune to these nuisance alarms is crucial in the current financial climate to keep productivity up and running costs down.

Flame simulation test

Testing flame detectors can often be a complicated and rigorous process, as verification of their ability to detect flame in a hazardous area is virtually impossible as there is no opportunity to expose the detector to a flame.

Therefore a simulation of the flame is required; the FS301 flame simulator provides a solution. It can dependably activate an FDS300 or FDS301 from a distance of up to 8m. Again, this further reduces maintenance costs by eliminating the need for scaffolds or ladders when testing the device.

A suitable alternative?

Most of the installed base of fire detection equipment is based on analysis of the UV and IR emissions from flames and, as a consequence, are prone to many false alarms. Many of the inherent benefits of vision technology have been outlined and the particularly difficult applications that have proved problematic in the past for conventional flame detection technologies have been illustrated.

With the quantum leaps in performance and capabilities of digital signal processing, offering virtually unlimited capabilities in processing information, and lower cost megapixel imaging sensors, the anticipated result will be greater sensitivity, range and image resolution of visual flame. It is anticipated this technology will soon become the default strategy for dependable fire detection.

For more information:
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