

Intelligent Video Surveillance for Ports and Harbours

Phil Dennis, Business Director of Advanced Research & Technology, outlines recent developments in technology for Port security

The Challenges

Protecting Ports and Harbours from security threats is difficult and expensive. Traditional site surveillance depends on the challenging task of maintaining continuous, reliable vigilance by security personnel.

Effective protection from sea borne threats has the additional challenge of trying to detect small craft in relatively large areas of water.

Monitoring fences and responding to false alarms from shore-based installations is time consuming and can be labour intensive.

New Solutions

Recent advances in 'Intelligent Video' systems, combined with reductions in the cost of Thermal Imaging cameras, have enabled better ways to detect potential threats when compared to traditional surveillance techniques.

Thermal Imaging cameras have the ability to detect very small changes in the surface temperature of objects at great distance, for instance it is possible to produce a thermographic image (temperature map) of the earth from space. TI cameras have been in use for military and scientific applications for many years but the technology was expensive and needed regular maintenance. Improvements in the manufacturing process have now made TI cameras more affordable.



Relatively low cost TI cameras can easily depict the thermal image of a small vessel at several kilometres, they need no light whatsoever to function; the coldest, darkest night presents no challenge. Objects are detected by small temperature differences on their surface. However, the scene depicted by a TI camera needs careful interpretation, in most cases the human eye is an inappropriate tool to detect objects that may be classified as potential threats. This is where 'visual intelligence' plays an important role; such systems can be given a set of instructions to determine if objects in a thermal image meet pre-set warning criteria, and if they do, to raise an alarm.

The picture below is a composite view from three TI cameras showing the protection zone (in red) around a tanker off-loading Liquefied Natural Gas at a pier and terminal. Objects conforming to pre-defined criteria entering the zone alert security staff.



The Benefits of Intelligent Video Systems

Unlike human surveillance operatives, Intelligent Video Systems suffer no strain or boredom from monotonous tasks, they provide a true 24/7 capability and are much easier to sustain than their human counterparts, whose optimum concentration is maintained for only a few minutes. 'Real time' analysis of complex scenes by modern machine vision techniques is more consistent and can be considerably more accurate than reliance on human eyes.

The use of Intelligent Video Systems will eventually transform the way companies and governments protect high value assets. The realization that machine 'visual intelligence' can be more reliable and cost effective than humans for routine surveillance will enable users to reduce surveillance budgets and increase the effectiveness of response teams. Budget allocations can be shifted in favour of response teams and the equipment needed to facilitate appropriate responses.

RADAR

In general, it is possible to obtain more data from a Thermal Image than from RADAR, especially where targets are not equipped with RADAR reflectors. Using TI cameras and 'visual intelligence', range and bearing can be obtained from multiple targets and displayed on a PC monitor alongside the visual image of the targets. Detection distances can range continuously from a few tens of meters out to the horizon. RADAR system can have difficulty displaying this continuous range without adjustment. Some RADAR systems, using surface wave technology, can 'see' over the horizon but, because of the relatively long wavelength, they cannot show sufficient detail to establish threat, only presence. TI cameras and Visual Intelligence systems can perform an important role, alongside RADAR, in providing short and medium range surveillance.

The Bigger Picture

Visual Intelligence Systems present many opportunities to improve surveillance and security. They range from the basic concept outlined above, to tracking objects, detecting interaction of objects with 'Virtual Sensors' placed in views of the ocean, plotting detected objects into maps, determining range, bearing, latitude and longitude of detected objects.... etc. the list is considerable. Once the geographic position of a suspect is known, powerful visual cameras or other means can be automatically directed to provide detailed visual images for threat assessment and co-ordinated response.

The system can also be used to monitor berthed vessels and vessels at anchor, thus providing protection for crew and cargo.

Furthermore, IP networks can be used to connect intelligent video systems together providing a multi-disciplinary dimension to security. Video data can be instantly available to Harbourmaster, Immigration Control, Police, Homeland Defence, Coast Guard, Military, etc.

Networked Visual Intelligence Systems offer a comprehensive surveillance package for all types of vessel-berthing facilities.



Fence lines can be monitored by multiple technologies, including; motion detectors attached to fences, microphones, TI cameras and standard visual spectrum cameras. In this picture 'virtual sensors' (the red and yellow lines placed in the image) are used to locate and track people by a visual intelligence system.

All data from these multiple sources can be analysed by the system and threat levels determined accordingly. Operators can be presented with precise visual information regarding the exact location of the threat in text and map form and can, if appropriate, allow the system to initiate first line 'discouragement' in the form of illumination and verbal or acoustic warnings at the location of the alarm event.

The sea threat elements of the system are fully compatible with the land-based elements and form an easily managed composite system requiring minimum user interaction.

The picture below shows an alternative view of the pier and terminal, without the LNG tanker present, again with the protection zone shown in red.



The area inside the red line is the protected zone

The white lines show the fields of view of the TI cameras

Target positions are transposed from camera views and plotted into the map at the actual geographic coordinates

The movements of all objects, including people on the pier, are plotted onto this scene and represented by coloured dots. Anything crossing the red line from the unprotected area into the protected area will raise an alarm to draw the attention of security staff.

Visual Intelligence Systems are already in use at strategically important sites in the UK and are proving to be reliable and effective. AR&T believe the future will see Visual Intelligence systems introduced at virtually all sea terminals where high value assets are at risk.