Smart Fire Prevention

Using VIP Vision Thermal Cameras to Detect Fire

Release 1.0

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1 Introduction to Thermal Imaging

Images recorded from traditional camera devices are generated by visible light reflecting off object surfaces. Since humans can only see wavelengths within the visible light spectrum, which range from 0.38~0.78μm (Figure 1), traditional camera surveillance has generally been able to solve basic monitoring requirements.
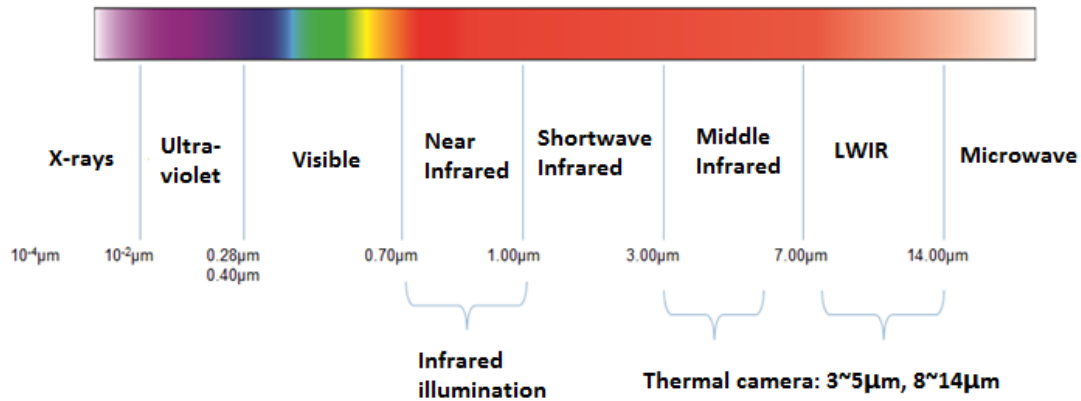

Figure 1: Electromagnetic spectrum wavelengths

In contrast, thermal cameras are designed to detect radiation with wider wavelengths, which is called thermal or infrared radiation. All objects with a temperature above absolute zero, also known as 0 Kelvin (0 K or -273 °C or -459 °F), emit infrared radiation. This kind of radiation is not visible to human eyes, but can be visualized by using a special type of sensor technology called thermal imaging technology. The advancement of thermal imaging technology has opened up a number of possibilities for advanced surveillance objectives which traditional cameras cannot accomplish, such as equipment monitoring, border surveillance, and fire detection.

The thermal camera imaging process is shown in Figure 2. It involves an infrared detector, optical lens, signal processing system, electronic components, protective shield, and other components.
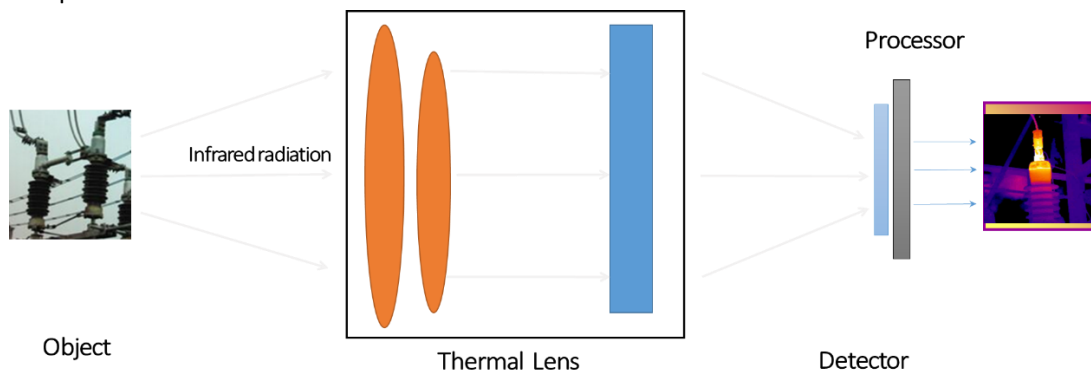

Figure 2: Thermal camera imaging process

2   Detecting Fires with VIP Vision Thermal Cameras

Thermal cameras can detect mild differences in temperature change, and automatically perform a temperature distribution of the captured video. This feature allows thermal camera to detect objects with a large temperature difference compared to the average temperature of the scene. As fires usually have much higher temperatures than the surrounding environment, VIP Vision thermal cameras are able to detect the presence of fire.

2.1   Mode Selection

Built-in fire detection algorithms provide VIP Vision thermal camera with the ability to detect fire from long range. There are two automatic fire detection modes: anti-jamming mode and high response mode.

2.1.1   High Response Mode

High response mode detects fire depending on the relative temperature difference between fire and the background. When the temperature of an object or area is several times higher than the average temperature of the current scene, the camera will trigger a fire alarm, and all objects which have reached or exceeded the temperature threshold will be detected and tagged as a suspected fire.

Advantages: High sensitivity, can detect all high temperature objects, low missed alarm rate.

Disadvantages: High false alarm rate, unable to distinguish between high temperature objects such as a boiler, and fire. This mode is recommended to be used in long range detection scenarios and in areas with low tolerance of missed alarms.

2.1.2   Anti-jamming Mode

Based on high response mode, anti-jamming mode adds analysis and judgment of fire features, such as shape, size, fire burning characteristics, etc. It estimates whether there is a fire or not through multiple criteria, rather than merely temperature difference.

Advantages: Moderate sensitivity, can distinguish between fire and common static objects with high temperatures.

Disadvantages: When a target is far away from the thermal camera, it will lead to missed alarms if the size of fire is too small in the thermal view. For this reason, the fire size should reach a certain amount of pixels. Thus this mode is recommended in short or medium range detection in areas that require high fire alarm accuracy.

3   Detection Range

Lens(mm)	Area（H×W）	Area	Effective distance	Max. distance
7mm	1m×1m	1 m²	300m	420m
13mm	1m×1m	1 m²	550m	770m
19mm	1m×1m	1 m²	800m	1200m
25mm	1m×1m	1 m²	1100m	1500m
35mm	1m×1m	1 m²	1500m	2100m
50mm	1m×1m	1 m²	2100m	3000m
60mm	1m×1m	1 m²	2600m	3600m
75mm	1m×1m	1 m²	3200m	4500m
100mm	1m×1m	1 m²	4500m	6000m
150mm	1m×1m	1 m²	6000m	8800m

Table 1: Detection range for various lens configurations

Note: This table is only for reference: actual performance may vary due to other factors, such as fire size, the temperature difference between the fire and the background, atmospheric transmission (air conditions), and the physical installation.

As shown in Figure 3, a thermal camera with 75mm lens can detect and tag fires from 2km and 5km away.
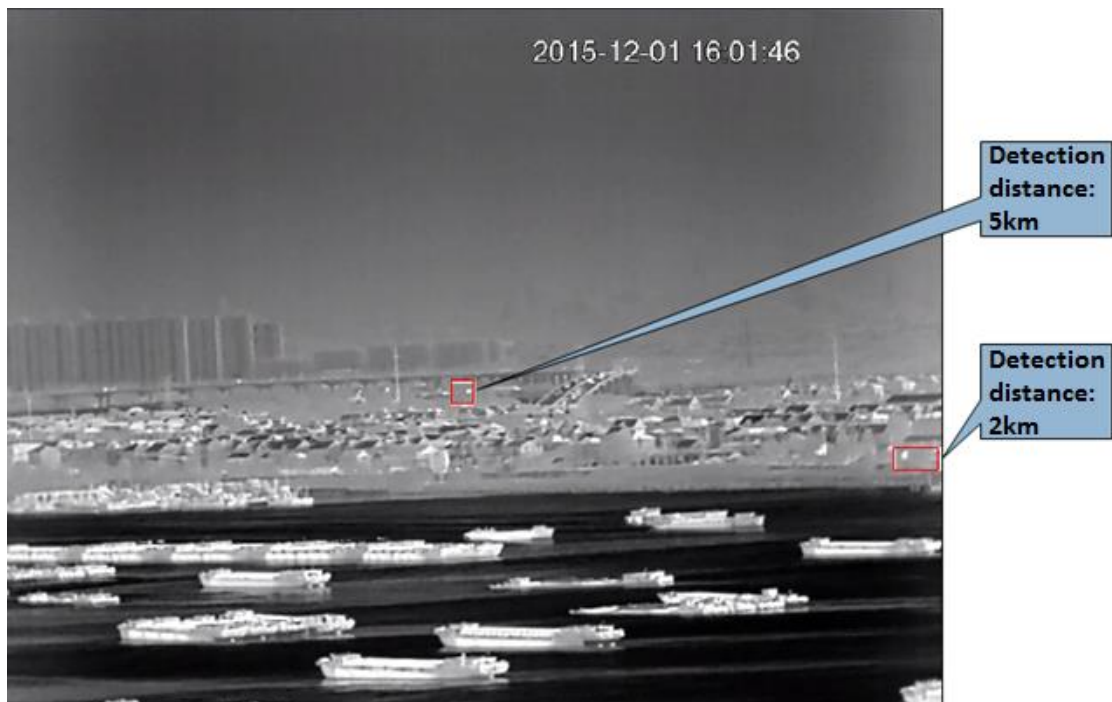

Figure 3: Fire detection and alarm

4 Application Scenarios

4.1 Small Scale Solutions

Small scale solutions are suitable for fire prevention and security in small areas, such as factories, parks, and museums. VIP Vision provides products and portable management software, which can allow users to easily build a lightweight thermal surveillance system.
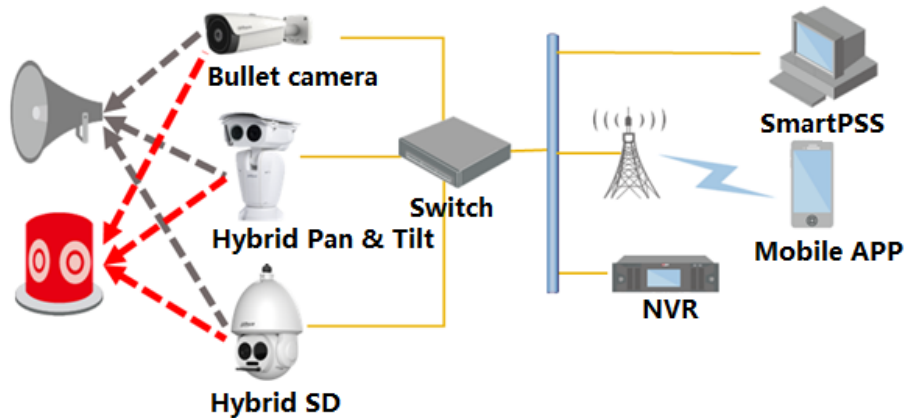

Figure 4: Network applications for small scale solutions

4.2 Integrated Solutions

Integrated solutions are suitable for fire prevention and security in large spaces, such as forest fire prevention and city fire prevention applications. With VIP Vision enterprise level software platforms and storage, it's an ideal solution for large area fire monitoring.
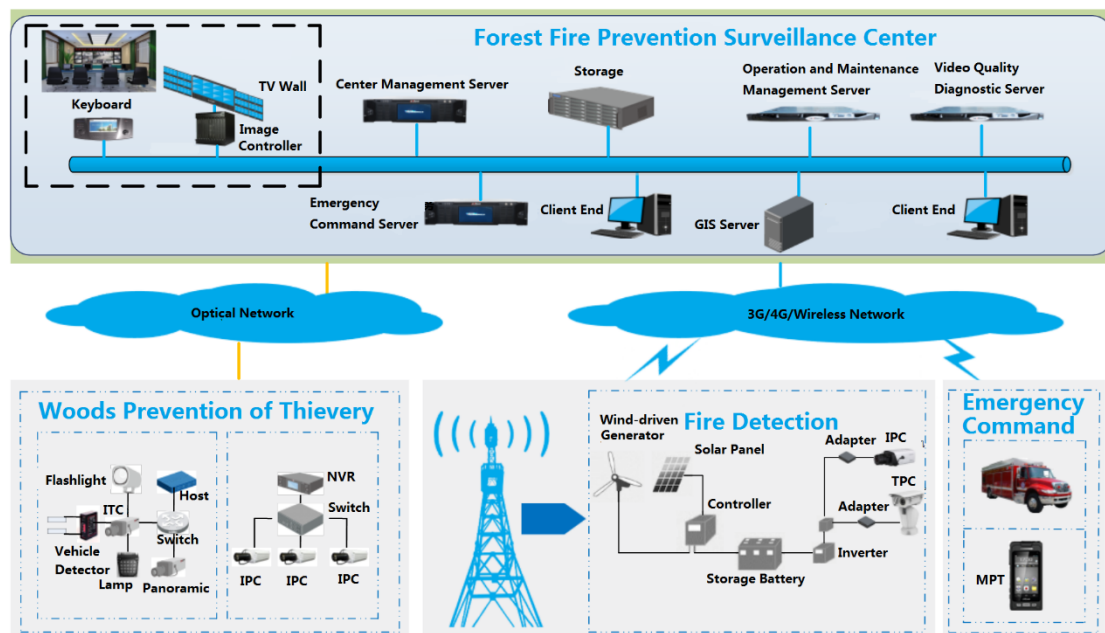

Figure 5: Network applications for large scale solutions