Comparing Thermal and Visible Cameras

The use of video is by far the most popular and effective means of security surveillance, as it provides a quick and efficient means to confirm the details of a scenario – mainly real time images. It also serves as an extremely large data source, which can be effectively used by video analytics algorithms and artificial intelligence neural nets to provide automated detection and response.

Although the choice to use video may be an easy decision, choosing the *type* of video that best serves your detection needs and budget is a bit more challenging. Specifically, the decision to use visible light color cameras versus thermal cameras, is dependent on many factors, including the mission of each camera, the intent to automate detection with video analytics, detection accuracy requirements, operating environment, budget considerations, etc.

The following image and textual comparisons are provided to help you further evaluate the advantages and disadvantages of these two sensor types. Provided are some key capabilities you might consider in addressing sensor performance, along with a description as to how a visible camera and a thermal camera meet those capabilities.

This is intended to be an overview and not an exhausted list, as specific detection scenarios may present other points of comparison. However, it should provide a good starting point for analysis.

Identifying People

Although the thermal camera image excludes some details that may be distracting, such as the person's shadow, it does not allow for a specific identification of "who" is in the image.

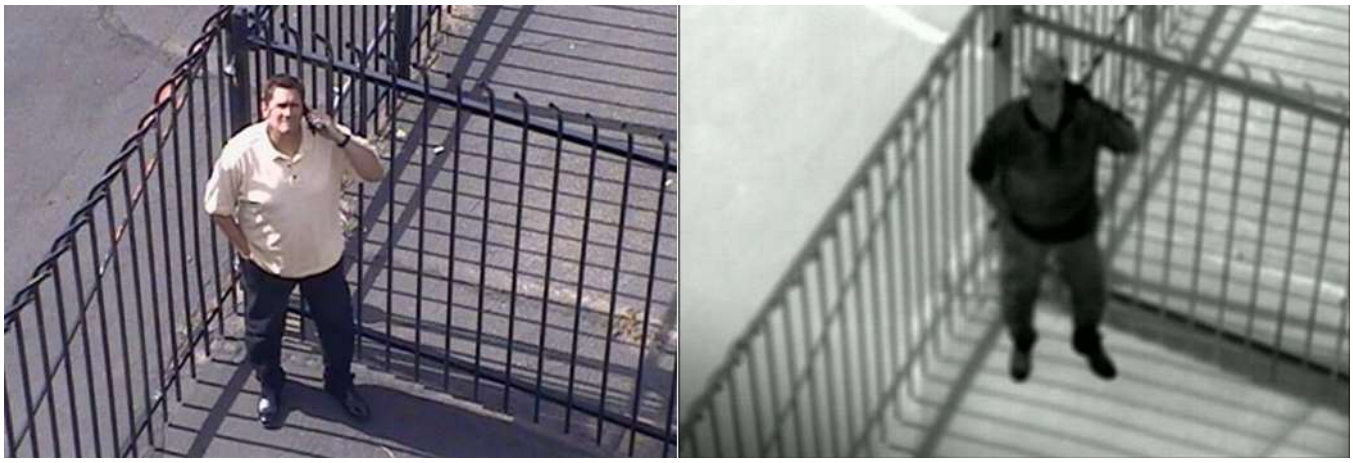

Figure 1 – Identifying: Visible versus Thermal Cameras

Character Analysis / Through Glass Viewing

Given enough pixels, visible cameras can be used to analyze identifying characters, such as, license plates. Similarly, if viewing through glass is a requirement, thermal cameras will not provide this capability.

Figure 2 – Character Analysis / Glass: Visible versus Thermal Cameras

Figure 3 – Character Analysis / Glass: Visible versus Thermal Cameras

Detection

For surveillance scenarios where detection is paramount in all types of lighting and weather conditions, thermal cameras prove to have far superior performance over visible cameras.

Figure 4 – Detection: Visible versus Thermal Cameras

Figure 5 – Detection: Visible versus Thermal Cameras

ID	Capability	Visible Day/Night Color Camera	Thermal Camera
1	Low Light /Night Time Operation	Must have illumination for night time operations; either visible or IR lighting. Adding light can be costly. It can be very difficult to get the IR lighting and camera fields of views aligned. Lighting can interfere (e.g. blind opposing cameras) with detection if not designed and installed properly.	No lighting required.
2	Poor Weather Performance	Perform poorly in low visibility conditions, such as fog, rain, snow, and blowing dust.	Affected to a much lesser extent during low visibility conditions (fog, rain, snow, blowing dust, etc.)
3	Ability to Identify an Object	Better for identification (e.g. “That is Mr. Smith” or “the license plate reads BR549”). However, such level of detail requires sufficient pixels on target (e.g. ~4000 pixels on a face or license plate) which must be achieved through a very high-resolution camera, a closer camera mounting location or the ability to steer and zoom a PTZ camera towards the target for closer inspection. In each case, the target must have sufficient ambient illumination.	Much harder to identify a unique person, or identify specific features, such as license plate numbers. A visible PTZ camera with sufficient illumination can be used to point and steer at the object to identify.
4	Available Image Resolutions	A wider range of camera resolutions are available in this category at substantially lower cost, including the much higher 12 MP and 4K resolution cameras, providing more detailed information about the imaged subjects and/or greater coverage compared with their thermal counterparts, as long as sufficient illumination levels are achieved.	640 x 480 is the standard resolution for thermal cameras, however, 720P and 1080P uncooled thermal cameras are available.
5	Nuisance Alarm Rate	Visible cameras can be affected to a greater extent by weather and lighting conditions (e.g. rolling clouds, headlights).	Thermals cameras will generally result in a lower nuisance alarm rate than visible cameras.

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6	Use with Machine Learning	Can benefit immensely by using Machine Learning resulting in better target classification and can address nuisance alarms from weather and lighting changes, to which visible cameras are more susceptible. Machine Learning does require more pixels on the detected target, which means higher resolution or more cameras are needed. By virtue of offering more pixels per camera at lesser cost, compared with their thermal counterpart, it can be said that visible cameras are more apt to benefit from machine learning, as long as sufficient illumination levels are achieved.	Can benefit immensely by using Machine Learning, resulting in better target classification. Machine Learning does require more pixels on the detected target, which means higher resolution or more cameras are needed.
7	Determining Geolocation	Assuming the analytics software is capable, of georeferencing, the ability to provide the latitude, longitude, elevation and real-size of a target through the use of video analytics works equally well for visible and thermal cameras. The benefits of geolocation are enables PTZ cameras to be automatically pointed at detected targets, and more accurate automatic object classification, since the real-size of the object can be computed.	Assuming the analytics software is capable, of georeferencing, the ability to provide the latitude, longitude, elevation and real-size of a target through the use of video analytics works equally well for visible and thermal cameras. The benefits of geolocation are enables PTZ cameras to be automatically pointed at detected targets, and more accurate automatic object classification, since the real-size of the object can be computed.
8	CPU/GPU Processing Requirements	Computer processing required to process video images is equivalent to a thermal camera for a given resolution. However, use of higher resolutions readily available on visible cameras, result in higher CPU/GPU compute costs (e.g. a 1080P camera is equivalent to 6.75 640 x 480 resolution cameras and thus require 6.75 times the CPU/GPU power to process.)	Computer processing required to process video images is equivalent to a visible camera for a given resolution.
9	Cost	Lower camera cost (assuming sufficient lighting is already available).	Higher camera cost but requires no additional lighting.

Additional Information / Links

The following links provide additional clarity on the use of thermal cameras and their performance in surveillance scenarios. They may prove useful when considering what type of video imager will best meet your surveillance needs.

Video Analytics and Thermal Cameras	Article
Perimeter Security Using Video Analytics and Thermal Cameras	Video
Video Surveillance Considerations for Night Time Operation	Article

About PureTech Systems

PureTech Systems Inc. is a manufacturer of wide-area perimeter surveillance software solutions including internally developed outdoor video analytics, PTZ Auto Follow, multi-sensor integration and a map-based (real object size) command and control. It is offered to fortune 1000 firms, petro-chemical, water and electric utilities, seaports, airports and federal, state and local governments. With headquarters in Phoenix Arizona, PureTech Systems serves national and international markets. To find out more about PureTech Systems Inc. visit our website at www.puretechsystems.com , follow us on Twitter or sign up for our email list.