White Paper

FACTORS THAT INFLUENCE VIDEO ANALYTIC PERFORMANCE

aimetis

EXECUTIVE SUMMARY

There are many factors, both external and internal, that can influence the performance of computer vision based video analytics algorithms. Performance can vary greatly depending on the situation of the deployment setting. These factors can be broken into the following general categories – Environmental Factors, Computational Factors, and the Definition of Accuracy.

This White Paper will explore each of the above mentionned factors in detail, providing valuable insight for setting appropriate video analytics performance expectations and delivering accurate, consistent results.

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ENVIRONMENTAL FACTORS

Environmental factors have a tremendous influence over the performance of virtually all video analytics algorithms. There are six general environmental factors.

1. Camera Angle

The angle of the camera can influence several factors used in video analytics, including perspective, occlusion, and segmentation of objects.

2. Distance to Object

Pixel size of the object is an important element to video analytics. Most video analytics require a minimum pixel size (e.g. 15 x 15). Conversely, if the pixel sizes of the objects are too large, that too can distort the performance of the analytics (e.g. reflecting light into the camera).

3. Lighting Level

Lighting can influence video analytics in a few ways. First, in order for video analytics to detect objects, there needs to be some minimum light available (unless infrared or thermal cameras are being used). Second, abrupt changes in lighting (e.g. opening of doors) can cause false conclusions.

4. Degree of Activity

The degree of activity or "busyness" of an environment has influence over the performance of video analytics. Generally, the higher the level of activity, the more false conclusions will be drawn by the video analytics algorithm.

5. Weather

The volatility and variance of weather (sun, rain, snow, wind, trees, clouds, shadows, etc.) can cause false conclusion for video analytics, especially in outdoor environments. Weather also has impact on video analytics in indoor environments where there exist large glass windows and doors and the mentioned conditions create changes to the scene viewed by the indoor camera.

6. Backgrounds

The degree of change to the background of a camera view can impact the performance of video analytics. For instance, if the view of the camera includes a constantly moving escalator, this could result in false conclusions, and would be need to be taken into account when developing or installing a solution.

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COMPUTATIONAL FACTORS

Video analytics algorithms can vary greatly on the amount of computational power needed to perform adequately. There are five general factors that influence performance.

1. Processing Power

There are many different analytics engines. One can require 10x as much CPU as another. More CPU is normally required if you want to detect small objects moving quickly. This is because the engine would need to run at a high resolution (detect small objects) and also at a high frame rate (track fast objects).

2. Resolution

Normally you can record video at 4CIF, and do analysis at CIF which saves CPU. If you want to detect very small objects, you may have to run at 4CIF.

3. Frame Rate

Most analytics engines need between 5 and 8 frames per second. The record rate could be higher. Faster moving objects require higher FPS for tracking. Even left item detection analytics often use motion tracking to cut down on false positives.

4. Hard Disk

If you want to be able to search through analyzed footage (e.g. objects moving near a car), you will need to store the XML metadata produced by the analytics engine. This is normally a negligible amount of HD - a few percent of what the video storage requirements are.

5. Memory

An analytics engine usually requires an additional 10MB to 100MB when run on a PC. Higher resolutions need more memory.

Note: Figure 1 below is just a sample of some of the Aimetis video analytics algorithm and the variant environmental and computational requirements.

Figure 1 - Sample Aimetis Video Analytics Algorithm Requirements

Aimetis Algorithm	Environmental						Computational		
	Camera Angle	Camera Height	Minimum Pixels On Target	Light Requirement	Indoor/ Outdoor	Supported Level of Activity	Default FPS	Default Resolution	CPU Usage (2.4 GHz)
VE 130 Video Motion Detection/ Pixel Change	Any	Any	10x10	Low	Any	Any	1	4CIF	0.07%
VE 140 Cord Cut	Any	Any	N/A	None	Any	Any	1	CIF	0.0026%
VE 141 Camera Obstructed/ Scene Change	Any	Any	N/A	Medium	Any	High	1	4CIF	0.10%
VE 150 Outdoor Tracking/ Object Classification	30-60	6-10m	10x10	Low	Outdoor	Medium	5	4CIF	8.19%
VE 160 Overhead People Counting	Overhead	3m	20x20	Medium	Any	Medium	8	CIF	17.22%
VE 161 45 degree People Counting/ Dwell Time/Loitering	30-60	3m	15x15	Low	Any	Medium	8	CIF	13.87%
VE 250 Zero Configuration Tracking	Any	Any	15x15	Medium	Any	Medium	8	CIF	9.04%
VE 350 Left/Removed Item Detector	Any	Any	15x15	Medium	Any	Medium	6	CIF	6.86%
PT090 Automatic PTZ Following	30-60	6-10m	25x25	High	Outdoor	Low	8	CIF	9.04%

DEFINITION OF ACCURACY

Determining the "accuracy" of video analytics can sometimes be difficult, not only because of the uncontrollable factors discussed above, but also as it relates to the actual definition of "accuracy". This means different things to different people. Thus, setting proper customer expectations is important. Many times a customer will have a requirement for the degree of accuracy of the video analytics in order to assess the usefulness of the technology – e.g. 95% accuracy of Wrong Direction. While performance expectations are reasonable requests, the answer can be greatly influence by how the data set is defined.

Let's assume that in the month of January the number of people who exit an escalator properly (in the correct direction) is 100,000 and there was only one person per that month that tried to go the wrong way. Let's also assume that the video analytics properly detected the person moving in the wrong direction, but also incorrectly determined the direction of 300 people during the month and delivered a false alarm. Depending on the data set, the "level of accuracy" of the video analytics will vary greatly.

Interpretation #1: 100% Accuracy

In this interpretation, one could argue that only once during the month a person tried to go the 'wrong direction' and the video analytics correctly identified that event.

- Number of Events: 1
- Number of Detections: 1
- Accuracy Formula: 1 ÷ 1 = 100%

Interpretation #2: 0.3% Accuracy

In this interpretation, one could argue that video analytics delivered 301 events, of which only 1 was correct.

- Number of Events: 301
- Number of Detections: 1
- Accuracy Formula: 1 ÷ 301 = 0.3%

Interpretation #3: 99.7% Accuracy

In this interpretation, one could argue that video analytics evaluated 100,000 events (total people exiting the escalator in the month), and correctly identified 99,700 events.

- Number of Events: 100,000
- Number of Detections: 301
- Accuracy Formula: 99,700 ÷ 100,000 = 99.7%

The picture of accuracy is complex. The boundaries of definition are multiple – e.g. over time, number of events, etc. Thus, to properly set video analytics performance expectations, it is important to have a common understanding of what measurement criteria is being used.

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