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WAVE AI

Best Practice Guide

Best Practice Configuration
for Different Types of Analytics



AI Analytics Plugin

Best Practice Configuration for Different Types of Analytics

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Definitions and Performance Expectations

Intrusion Detection

Definition

Detects objects that move inside a defined intrusion area. The event is triggered for any new target object (person, vehicle, animal) entering the area.



Area Enter/Exit

Definition

Detects objects that enter/exit a defined area. This analytic can be employed to monitor objects detected in the area without triggering an intrusion event.



Please note that the default configuration is set to ignore stationary objects (for example, parked cars) to avoid triggering events on unmovable targets.

Area Exit/Enter vs Intrusion Detection: what's the difference?

Area Enter/Exit functionality closely resembles intrusion detection; however, it offers the flexibility of selecting whether to trigger events exclusively upon entry or exit.

The rationale behind maintaining separate functionalities for intrusion detection and enter/exit lies in the need for distinct actions in various scenarios. For instance, there are situations where monitoring an area is essential without triggering an intrusion alert. A practical example is monitoring pedestrian activity on a street to determine foot traffic, which does not constitute an intrusion.

Within a VMS, these analytics are presented as configurable events, offering users the ability to specify actions such as sending emails, SMS alerts, or other custom alerts. The inclusion of both intrusion detection and area enter/exit functionalities addresses diverse use cases, allowing for a nuanced approach to surveillance and response.

Loitering

Definition

Detects objects that stay in the defined area longer than a specified time. By default, an event will be triggered when a target object remains in the area for a duration of 10 seconds.



When configuring the "loitering" analytic type, it's crucial to customize the time threshold to suit your specific use-case requirements.

Please note that once an individual exits the designated zone, the timer resets automatically. Additionally, if a person leaves the camera's field of view and later re-enters, they are treated as a new target object. Consequently, any time spent in the zone before exit will not be considered for future loitering events.

Performance Expectations

The Loitering analytic is designed to detect when an object, such as a person or vehicle, remains in a defined area longer than a configured duration. It is ideal for scenarios where lingering behavior beyond a few seconds (typically 10-120 seconds) may be considered suspicious or require intervention.

Use Cases

- ATMs
- Drive-throughs
- Storefront entrances
- Restricted access zones
- Sidewalk encroachment monitoring

These use cases require strategic camera placement to ensure:

- A clear, unobstructed view of the detection area
- No occlusion from foreground or passing objects
- Sufficient elevation to reduce track loss caused by overlapping activity



Notes

This feature is not intended for long-term tracking of idle behavior, such as vehicles parked for extended periods in parking lots.

Behavior

- Once a loitering track begins, the system continues tracking the object as long as it remains visible and is not occluded.
- If the object is covered, either temporarily or permanently, the bounding box will be lost and the track may terminate.

Event Triggering

If a "Loitering Start" event is selected in the Camera Rules, the system will trigger the event once, at the moment the loitering duration threshold is met. It will not continue generating new events regardless of how long the object remains in the area after that point.

Object Left/Removed

Object Guarding

Definition

Detects when an object previously present in a defined zone is removed, which may indicate theft, tampering, or relocation.



Typical Use Cases:

- Monitoring valuable equipment or displays
- Guarding items in lobbies, storage areas, or restricted access zones
- Detecting removal of safety barriers or placed signs

Key Characteristics:

- Tracks the absence of an expected object
- Most effective when the object is clearly visible and not frequently moved

Object Left Behind

Definition

Detects when a new object appears and remains in the area beyond a defined threshold, suggesting it may have been unintentionally or deliberately left behind.



Typical Use Cases:

- Package deliveries
- Suspicious items placed in sensitive areas
- Unattended objects in hallways, entrances, or backyards

Key Characteristics:

- Sensitive to any change in the scene, regardless of object type
- Designed for low-traffic, static environments where objects don't frequently come and go

Performance Expectations

The Object Left Behind and Object Guarding analytics are designed to detect changes within a monitored area by identifying when an object is introduced or removed, respectively. Both features rely on a stable reference of the scene to compare against, and their effectiveness depends on clear visibility and minimal interference.

Scene Learning Requirement

After the analytic is configured, the system requires a short learning period to capture a baseline of the detection zone.

Allow at least 10 seconds of visual stability after setup or scene changes to ensure the plugin can accurately recognize when objects are added or removed.

Notes

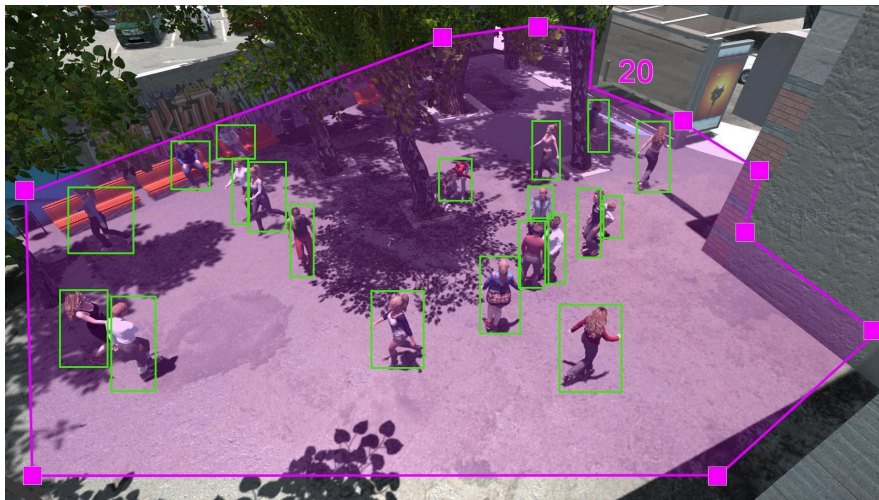
If the scene is still in motion or undergoing visual changes (e.g., people walking, carts moving, lighting shifts), the system may delay baseline initialization or fail to detect changes reliably.

Crowding

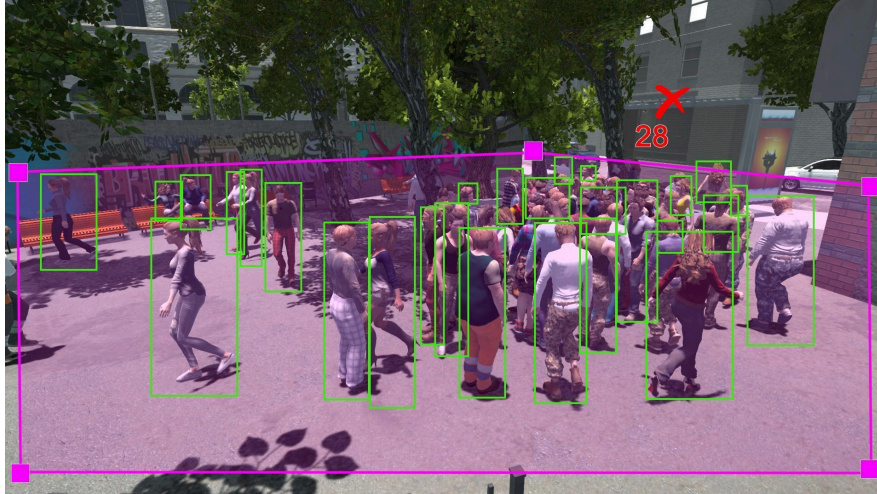
Definition

Detects when the number of objects within a defined area at any given time reaches a set threshold after a set time. For instance, it could be a useful analytic to detect a sudden increase of people in a queue in front of an ATM or in a commercial environment.

While there is no hard limit, it's suggested not to set a threshold too high. The value should be chosen in relation to the occlusions that can occur when too many objects are in the view.



In this example, the correct count would be higher than 28, but, because of the heavy occlusion, it's not possible to precisely count the number of people in the area.

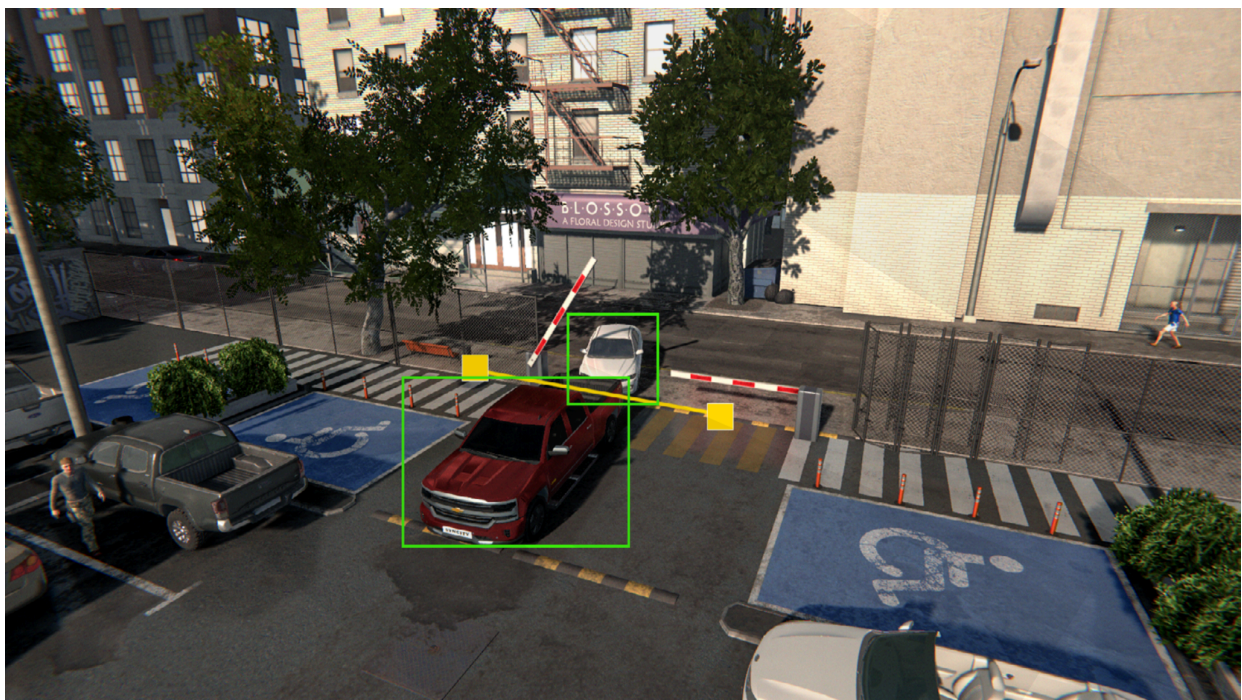


Once a crowding event is triggered, no additional alerts or bounding boxes will appear until a new event condition is met. For a new event to trigger, the number of people within the defined area must first drop below the configured threshold and then exceed it again. This behavior prevents repetitive or overlapping alerts while the scene remains crowded, ensuring that event logs reflect only meaningful changes in crowd density

Tailgating

Definition

The tailgating feature detects if more than one object crosses a virtual line during a predefined time interval. This feature could be useful for detection of multiple individuals or vehicles following each other in close proximity to gain access to a secured area.



Proper camera placement is crucial for effective detection. Ensure that the camera is positioned so that the objects do not occlude each other when passing through the virtual line.

For example, if the camera is placed too close to the ground, a smaller vehicle (e.g., a white car in the example image) could be fully occluded by a larger vehicle (e.g., a red pickup truck in the example image) passing in front of it, making detection difficult. Ensure the camera angle and height provide a clear view of all objects crossing the virtual line.

Line Crossing

Definition

Detects objects that cross a defined line. You have the option to create a multi-segment tripwire line. This feature allows you to select the direction in which you intend to monitor the movement of objects.



To mitigate double triggers resulting from bounding box flickering, a bandwidth is incorporated around the tripwire. It is imperative to note that tripwire crosses are anticipated to occur in a singular direction for a given object.

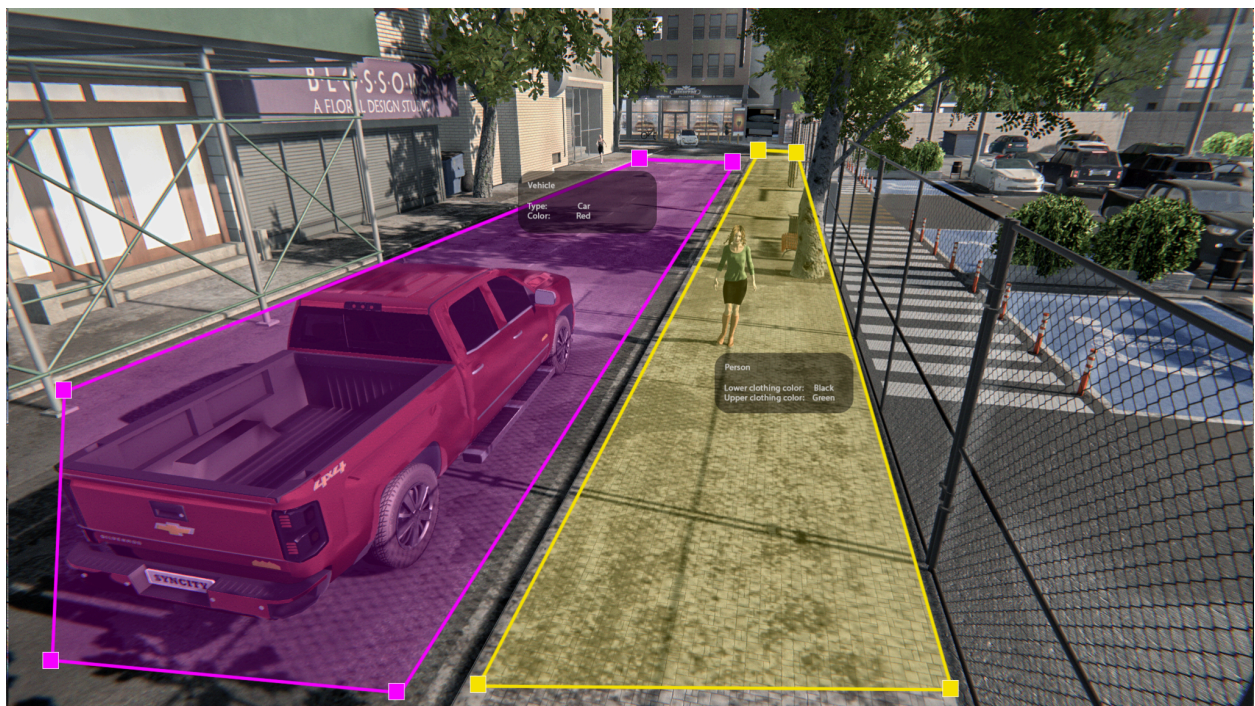
Furthermore, the tripwire crossing functionality exclusively triggers for objects identified as being in motion. When configuring tripwires, akin to zones, it is essential to account for a specified "margin." This ensures optimal performance and prevents unintended triggers. For instance, if the tripwire is situated too close to a bustling road adjacent to a sidewalk, it may inadvertently detect objects such as bikers or scooter riders on the road, rather than focusing on the intended area of the sidewalk.

Finally, do not place a tripwire too close to the edges of the view or to occluding walls. It's necessary to keep some space for the system to start tracking an object before it crosses the line, or to allow for a tracked object to fully cross the line bandwidth before disappearing.

Enhanced Appearance Search

Definition

Appearance Search feature allows users to leverage object search to identify objects matching search parameters based on an extensive list of attributes. This feature simplifies the process of locating specific individuals or vehicles within extensive video archives.



Collected Attributes

- Vehicles: Door open, Lights on, License Plate (searchable), Color, Type
- People: Gender, Wearing glasses, Age, Using phone, Carrying bag, Smoking, Face covered, Requires assistance, Upper clothing color, Lower clothing color, Tattoo, Surrender pose

Attributes are collected in real time while an object is being tracked. However, the full attribute list is shown in the UI only after the track ends. This means you might not see attributes while the object is still on screen with a visible bounding box. Once the track is no longer visible in

the scene, the thumbnail is updated with the finalized attributes and they become available for search. As a rule, there is a 4–5 second delay between the live video and the data shown in the interface.

Clothing Color and Vehicle Color

The AI network may face challenges when distinguishing between certain shades, such as black and gray or white and gray. These distinctions can become especially difficult in suboptimal lighting conditions, which may reduce the overall accuracy in color differentiation.

For example, a white shirt may appear bluish when in shadow and return to its true color under bright light. The system is designed to handle these variations by recording all colors detected on an object. This means an object may have multiple color attributes associated with it across different frames.

During retrospective search, any of the detected colors can be used to locate that object. While the color may not always be perfectly accurate due to lighting effects, what matters most is that the object is detectable and searchable. As long as the object appears in search results, the color detection has successfully fulfilled its purpose.

For optimal results, ensure your camera placement provides consistent lighting and minimizes harsh shadows where possible – but rest assured the system is built to accommodate real-world variability.

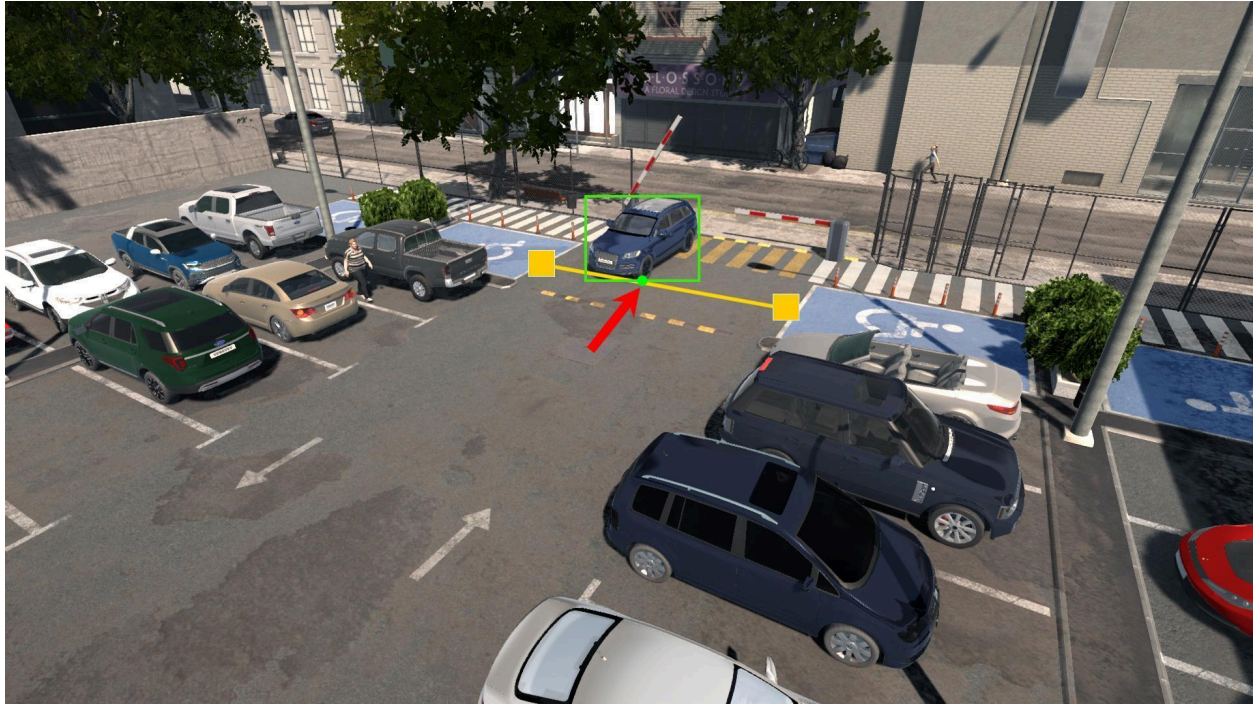
Drawing Detection Areas and Tripwires

The inclusion area (zone) refers to the region in which the analytics identifies objects. Events are triggered for objects only if their detection point falls within this inclusion area. Detection events will not be triggered by activity outside of the detection area.



Detection Points for Zones and Tripwires

Consider the *anchor point* (the primary detection point) of the objects you aim to detect. For inclusion areas, it's the center of the objects. For tripwires, it's the bottom center of the bounding box.



Track Age

Track Age refers to the duration of time an object (such as a person, vehicle, or animal) has been continuously tracked by the system from the moment it is first detected. This metric is crucial for reducing redundant alerts, ensuring that only one alert is generated per security event, instead of multiple alerts for the same object.

Track Age is instrumental in implementing loitering detection logic. For instance, if an object's Track Age exceeds a predefined threshold (e.g., XX seconds), an alert can be triggered to indicate suspicious activity.

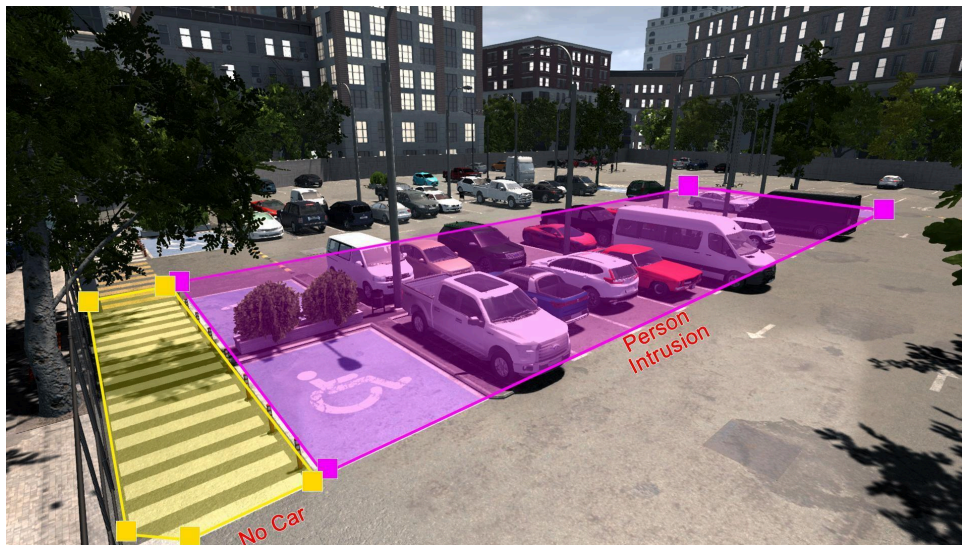
Shape and Dimensions of Detection Zones

Adjust the *shape and dimensions of the polygon* to encompass only the portion of the scene where object detection is needed. The inclusion area can be drawn as a convex or concave polygon.



Monitoring Multiple Zones

You can draw separate zones (areas) to detect different types of objects in different places of the scene. The zones can be visualized on the video in different colors for your convenience.



There is no limit to the number of detection areas that can be defined for each analytic type. For an analytic to be active, a polygon needs to be drawn within an area.

Margin Around Detection Area

Consider incorporating a margin around the intrusion detection zone, especially when it is situated adjacent to high-traffic areas with anticipated movement, such as a parking lot adjacent to a busy road.

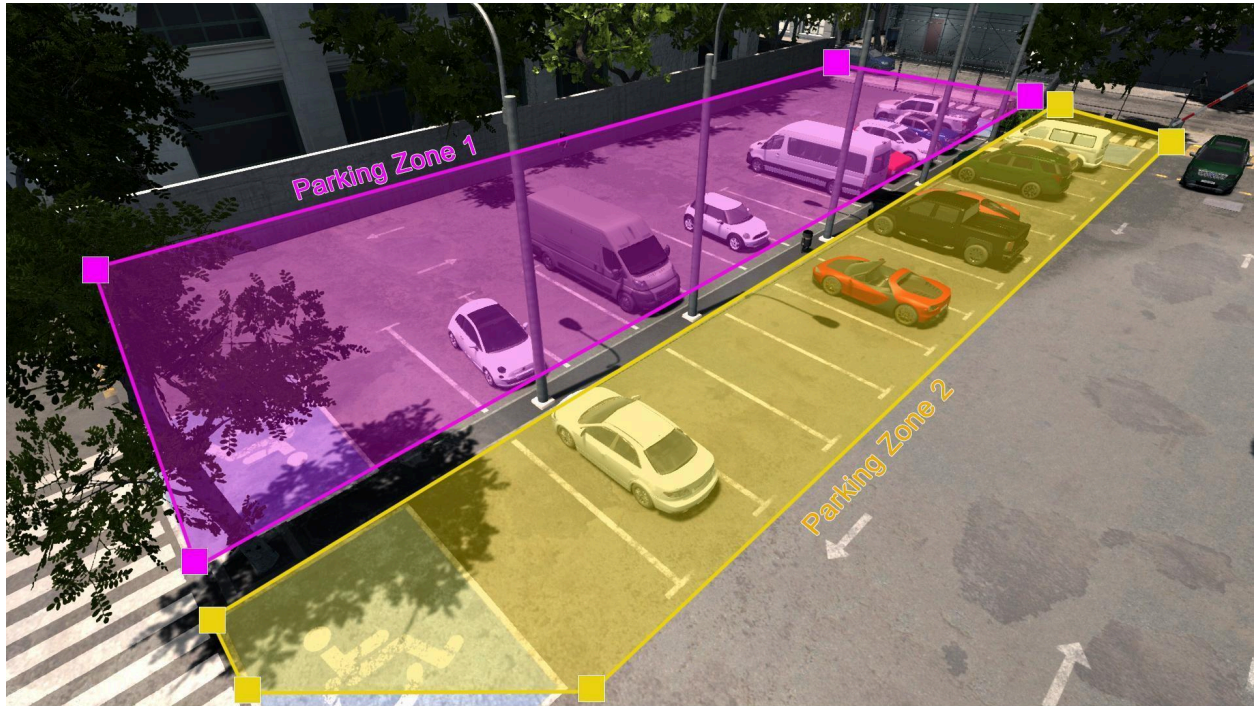




This margin will act as a buffer, helping to prevent potential False Positive events triggered by objects moving in the neighboring busy location. By introducing this precautionary measure, you can enhance the accuracy and reliability of intrusion detection in dynamic environments with varying levels of activity.

Zone Names

Assigning names to zones is optional but becomes beneficial after drawing polygons when aiming to generate events with detailed information. By associating specific names with drawn polygons, you enhance the clarity and organization of event-related data, streamlining the analysis and retrieval of information.



Boost Accuracy of Detection

False Positive Sources (Wrong Detections)

Certain weather conditions (like rain and snow) can be problematic for intrusion detection on exterior locations since they can be a source of False Positive events. Reducing the motion sensitivity might help alleviate some of these issues, at the cost of potentially missing relevant intrusions.

Please consider these situations as potential sources of False Positive events:

- Individuals or automobiles partially obscured from view. For example, a small van emerging from the rear of a structure might resemble a person due to the shape and perspective.
- Presence of insects on the camera lens. Cameras equipped for day-and-night use with infrared illumination may attract insects and spiders.
- A mix of vehicle headlights and intense rainfall.
- Animals in a pose comparable to humans.
- Strong light leading to the formation of shadows.

False Negative Sources (Missed Detections)

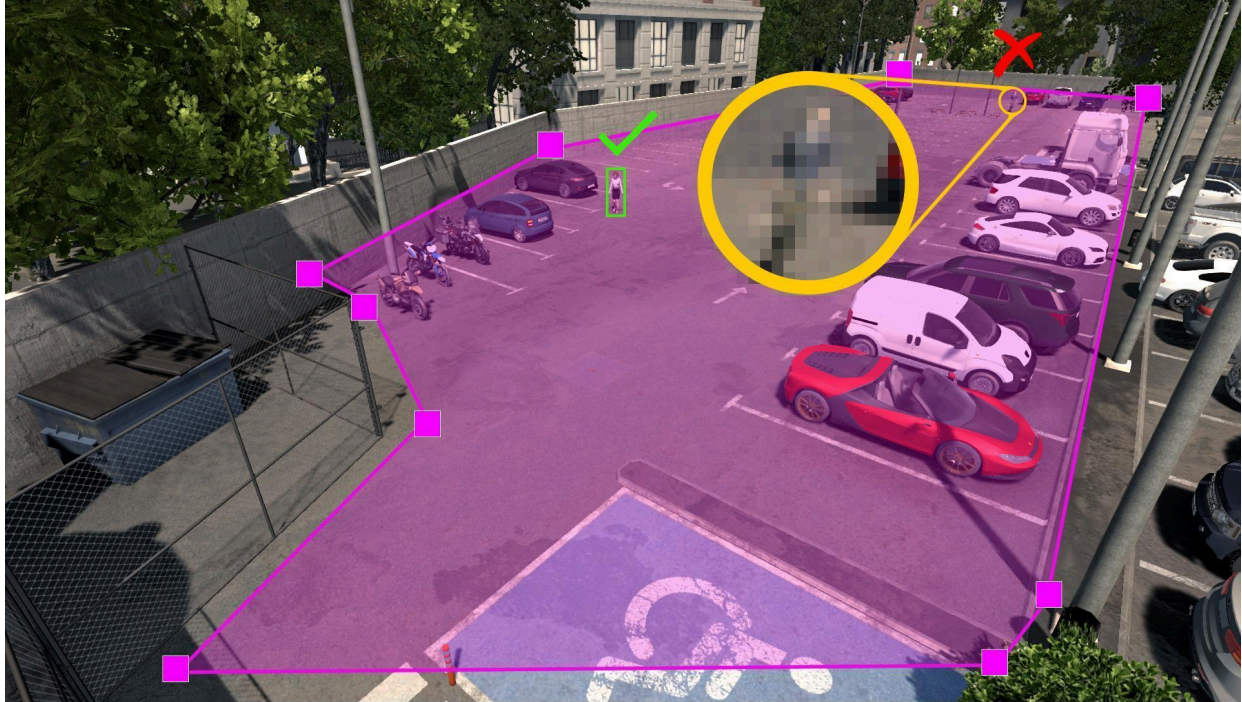
Weather Conditions

Fog, direct light shining on the camera, inadequate light might cause missed detections.

Thermal detection performance is highly influenced by ambient temperature, as it directly impacts image contrast. For example, detecting a person with a body temperature of approximately 36°C can be particularly challenging on a hot day when the ambient temperature is around 30°C. This reduced temperature contrast makes distinguishing the person from the background more difficult.

Object Size

Very small targets (smaller than 12×12 pixels) could cause missed detections. The smaller the target, the higher the risk of a False Negative.



To detect smaller targets, it is recommended to use the “Hi-res” mode of the plugin. This mode uses the primary stream and a larger AI network, improving the detection of smaller objects. For more details on Hi-res mode and additional configuration options, please refer to the User Manual.

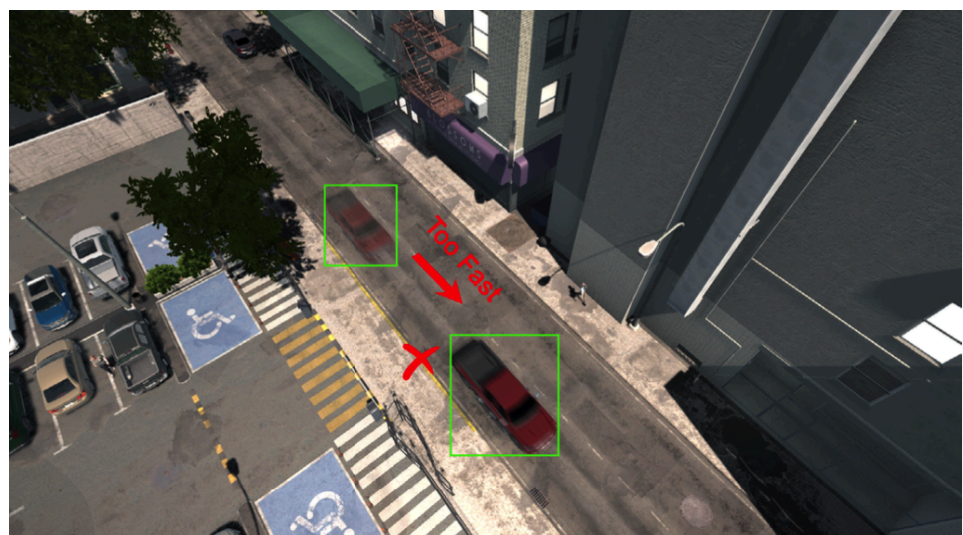
Movement Sensitivity Settings

Event Duration

Short-spanned events that last less than two seconds (like a person appearing and disappearing right away) typically require higher sensitivity.

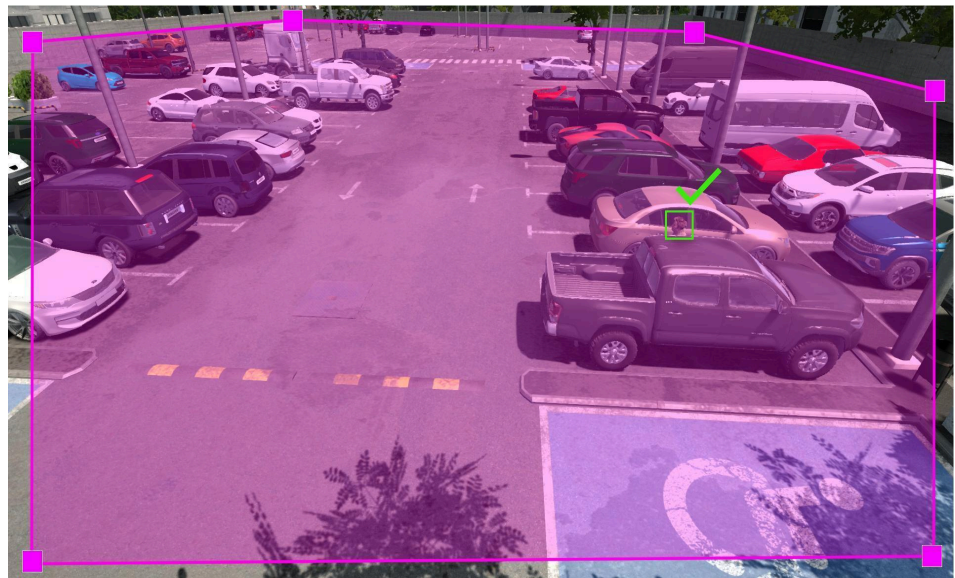
Object Speed

If an object moves more than its own size between frames, it can be very hard to track. Hence, fast-moving vehicles (or people on scooters, for instance) can be challenging to detect as intruders. Please be sure to use high movement sensitivity and set at least 10 FPS on the camera stream in use if you plan to catch those.



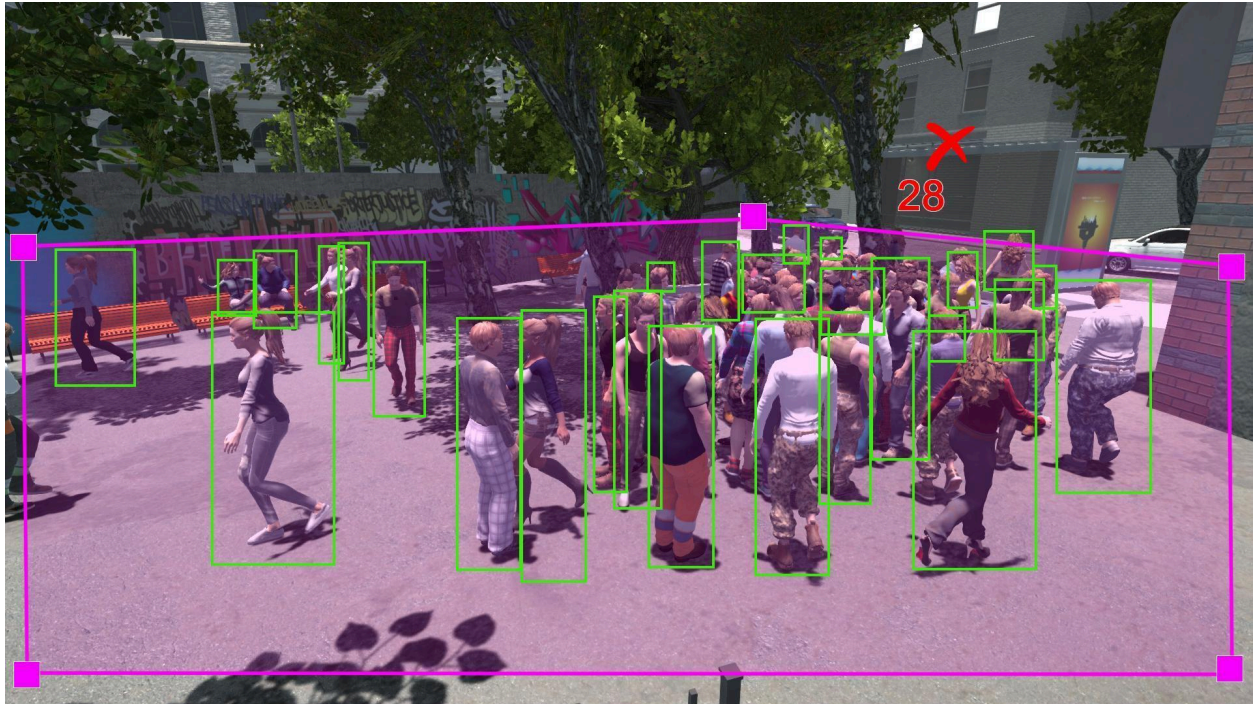
Occlusions

Detecting objects moving behind other objects can be challenging, especially if they are small. Try to minimize the number of occlusions to improve results, by placing the camera in positions with better viewing angles.



Object Quantity

When employing analytics such as Crowding or Intrusion, it is important to adjust the camera angle to minimize overlapping of the target objects.



Scene Density

The number of targets within a scene does not impact system performance when using features from the Standard SecuRT package: Intrusion Detection, Loitering, Area Enter/Exit, Tripwire Crossing, Crowding, Tailgating, Object Guarding, and Object Left Behind. With these features system performance remains consistent regardless of scene density.

For the Appearance Search feature, however, scene density becomes more important. This functionality involves sending cropped images of detected targets to a classifier, which analyzes object colors and vehicle types. The system is designed to handle multiple objects at once. For example, it can process up to 8 vehicles or people simultaneously without any additional computational load compared to processing just one. However, in more crowded scenes it will take more time to complete the task.

In crowded scenes, occlusions (when objects block or overlap each other) can reduce target visibility, which may lead to missed or duplicate detections. This is an important consideration for features like Crowding and Tailgating.

For Crowding Detection, the system is expected to track and count target objects within a defined area. Occlusions can disrupt the system's ability to determine the true density, resulting in incorrect crowd estimates or failure to trigger alerts.

For Tailgating Detection, which monitors whether multiple objects cross a virtual line in close proximity, it is crucial to position the camera at an angle that minimizes overlapping objects. Occlusions can hinder the system's ability to detect tailgating events accurately.

For more information visit us at
HanwhaVisionAmerica.com



Hanwha Vision America
500 Frank W. Burr Blvd. Suite 43 Teaneck, NJ 07666
Toll Free : +1.877.213.1222
Direct : +1.201.325.6920
Fax : +1.201.373.0124
www.HanwhaVisionAmerica.com

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