



# User Manual

MOBOTIX AI-TECH Video Analytics App

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# Support

If you need technical support, please contact your MOBOTIX dealer. If your dealer cannot help you, he will contact the support channel to get an answer for you as quickly as possible.

If you have internet access, you can open the MOBOTIX help desk to find additional information and software updates. Please visit:

[www.mobotix.com](http://www.mobotix.com) > **Support** > **Help Desk**





# Imprint

This document is part of the camera manufactured by MOBOTIX AG (called manufacturer in the following); the document describes how to use and to configure the camera and its components.

Subject to change without notice.

## Copyright Information

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## Support

See [Support](#), p. 5.

# Legal Notes

## Special Export Regulations!

Cameras with thermal image sensors ("thermal cameras") are subject to the special export regulations of the U.S.A. and including the ITAR (International Traffic in Arms Regulation):

- According to the currently applicable export regulations of the U.S.A. and the ITAR, cameras with thermal image sensors or parts thereof must not be exported to countries embargoed by the U.S.A., except if a special permit can be presented. At present, this applies to the following countries: Syria, Iran, Cuba, North Korea, Sudan and Krim. The same export ban applies to all persons and institutions listed in "The Denied Persons List" (see [www.bis.doc.gov](http://www.bis.doc.gov), "Policy Guidance > Lists of Parties of Concern"; <https://www.treasury.gov/resource-center/sanctions/sdn-list/pages/default.aspx>).
- Under no circumstances must the camera itself or its thermal image sensors be used in the design, the development or in the production of nuclear, biological or chemical weapons or in the weapons themselves.

## Legal aspects of video and sound recording:

You must comply with all data protection regulations for video and sound monitoring when using MOBOTIX AG products. Depending on national laws and the installation location of the AI-TECH Video Analytics App, the recording of video and sound data may be subject to special documentation or it may be prohibited. All users of MOBOTIX products are therefore required to familiarize themselves with all applicable regulations and to comply with these laws. MOBOTIX AG is not liable for any illegal use of its products.

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The products of MOBOTIX AG are certified according to the applicable regulations of the EC and other countries. You can find the declarations of conformity for the products of MOBOTIX AG on [www.mobotix.com](http://www.mobotix.com) under Support > Download Center > Certificates & Declarations of Conformity.

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The products of MOBOTIX AG are in full compliance with European Unions Restrictions of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS Directive 2011/65/EC) as far as they are subject to these regulations (for the RoHS Declaration of MOBOTIX, please see [www.mobotix.com](http://www.mobotix.com), Support > Download Center > Documentation > Brochures & Guides > Certificates).

## Disposal

Electrical and electronic products contain many valuable materials. For this reason, we recommend that you dispose of MOBOTIX products at the end of their service life in accordance with all legal requirements and regulations (or deposit these products at a municipal collection center). MOBOTIX products must not be



disposed of in household waste! If the product contains a battery, please dispose of the battery separately (the corresponding product manuals contain specific directions if the product contains a battery).

## Disclaimer

MOBOTIX AG does not assume any responsibility for damages, which are the result of improper use or failure to comply to the manuals or the applicable rules and regulations. Our General Terms and Conditions apply. You can download the current version of the **General Terms and Conditions** from our website at [www.mobotix.com](http://www.mobotix.com) by clicking on the corresponding link at the bottom of every page.



## AI-Dashboard embedded for data management

The data generated by AI-PEOPLE, AI-CROWD and AI-OVERCROWD can be stored on board on the SD card of the camera through AI-Dashboard embedded.

The data can be visualized in two different ways:

- In tabular form, as a sequence of events. In this case (optionally) a sequence of images associated to the events is available (not for AI-CROWD).
- The graphics related to the events generated by the plugins, with the possibility to personalize the time interval and the time resolution.

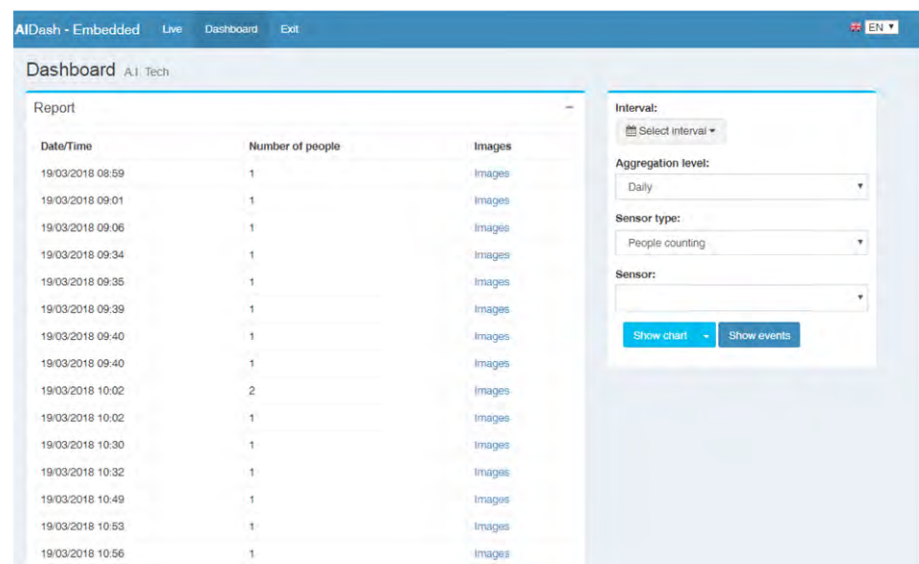


Fig. 1: Sequence of events

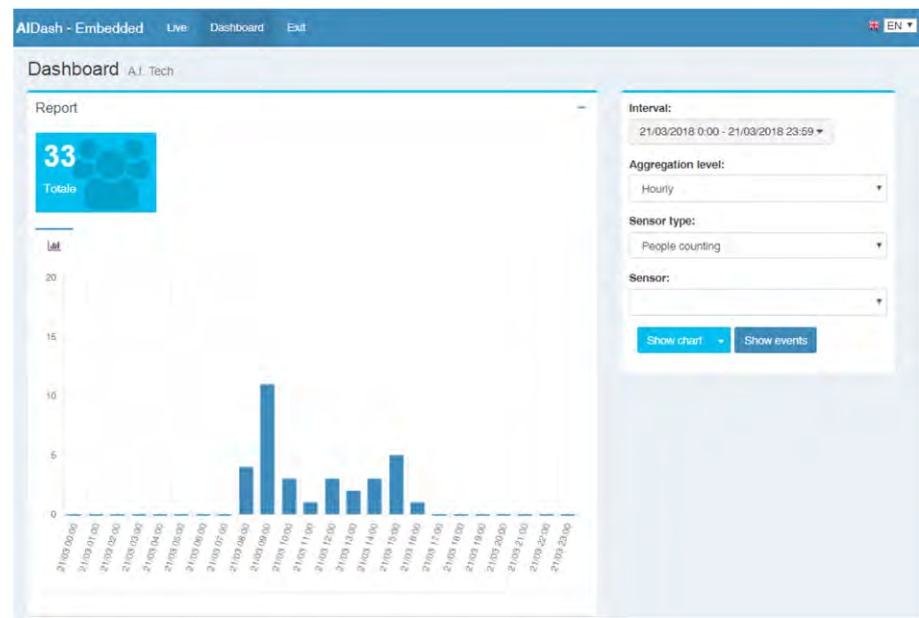


Fig. 2: Graphic

# AI-Dash - configuration overview

The dashboard in general is divided into the following sections:

- The main menu on top
- The live view area on the left
- The parameter section on the right

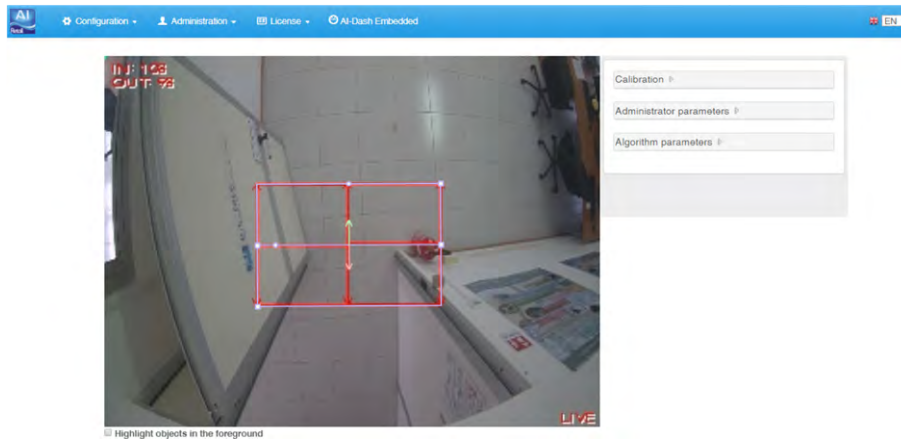


Fig. 3: Overview of the dashboard

## Menu configuration

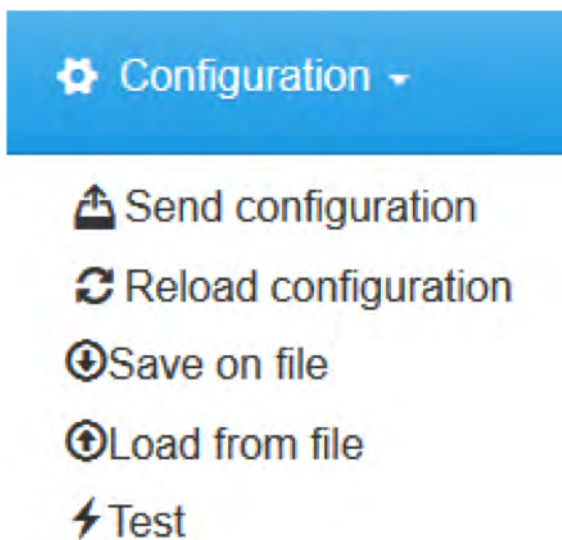


Fig. 4: Menu configuration

### Note:

Any changes made via AI-Config will only be applied to the application after the configuration has been sent using the function in this panel.

The following functions are available:

**Send configuration:** the configuration will be send and stored to the application.

**Reload configuration:** the current configuration will be loaded from the application .

**Save on file:** The configuration can be downloaded an saved as file in JSON format.

**Load from file:** The saved configuration can be loaded from a file in JSON format.

**Test:** sends a test event to all the enabled channels in order to verify that the configuration of the channels has been successful. Once clicked, simply click on the "Test" button in the window that will appear next. To exit the test mode, simply click anywhere on the screen.

## Menu Administration

ALWAYS STORE THE ADMINISTRATOR PASSWORD IN A SAFE PLACE!

If you have lost the administrator password and no other users with administrative privileges have been added in the meantime, accessing the system configuration settings will not be possible. The administrator password cannot be restored.

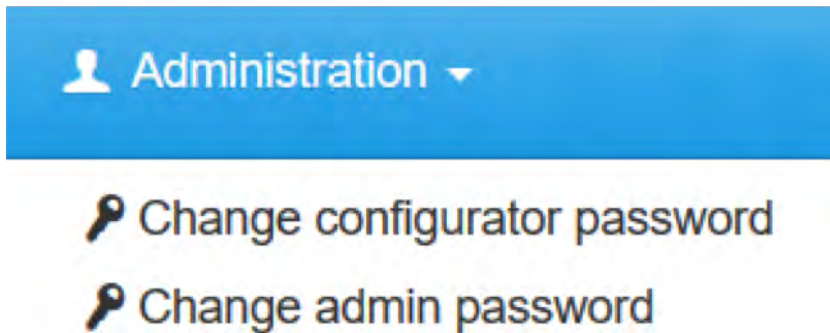


Fig. 5: Menu Administration

The following functions are available:

**Change configurator password:** a configurator can load a configuration but change the parameters

**Change admin password:** an administrator can fully edit all parameters.

## Menu License

Licensing is available in MxManagementCenter only .

## Highlight objects in the foreground

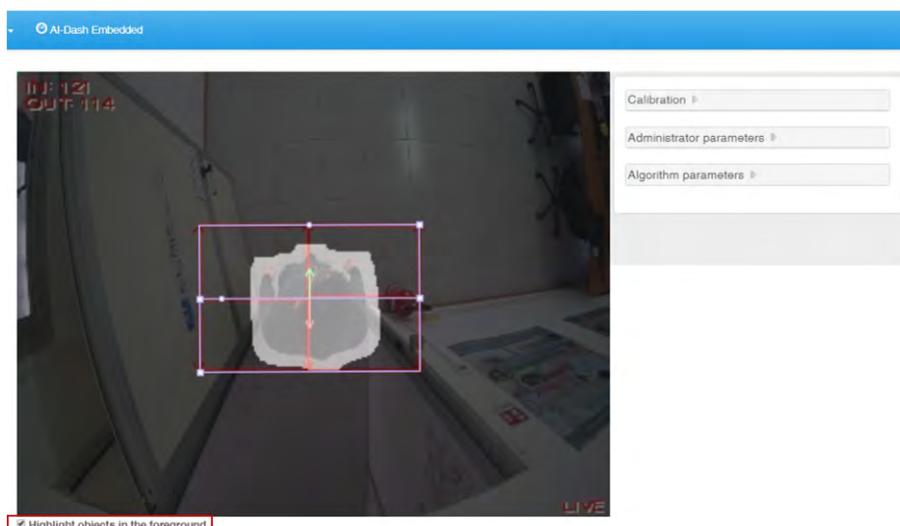


Fig. 6: Highlight objects in foreground

1. Activate Highlights objects in the foreground to verify if the configuration of the low level parameters is correct.

## Scheduler

Scheduler

Activation rules

default

Add rule

Remove rule

ID:

0

Rule name:

default

All day

Start time

00:00:00

End time

23:59:00

No date

Days of week

Sun

Mon

Tue

Wed

Thu

Fri

Sat

Deactivation rules

Fig. 7: Scheduler

In many real installations, applications do not always need to be active. It may be required, for example, to enable the processing only from Monday to Friday, or every day at a certain time interval.

For this reason AI-RETAIL can be scheduled by configuring the periods in which they must be active and those in which they do not.

# AI-Dash - Administrator parameters

For more experienced users, it is also possible to change the administrator parameters.

In this section, you can modify the low-level parameters that are required for background updating and extraction of the foreground mask. It is generally suggested that you do not change these parameters. However, the modification of these requires significant experience, so it was decided to protect this configuration with a password.

ALWAYS STORE THE ADMINISTRATOR PASSWORD IN A SAFE PLACE!

If you have lost the administrator password and no other users with administrative privileges have been added in the meantime, accessing the system configuration settings will not be possible. The administrator password cannot be restored.

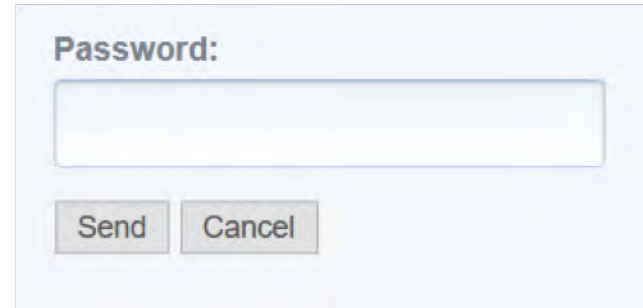
A light blue rectangular dialog box for administrator login. At the top left, the text "Password:" is displayed in a bold, dark font. Below this text is a single-line text input field. At the bottom of the dialog, there are two buttons: "Send" on the left and "Cancel" on the right, both with a light gray background and dark text.

Fig. 8: Administrator log in with password

## Face detection (AI-BIO only)

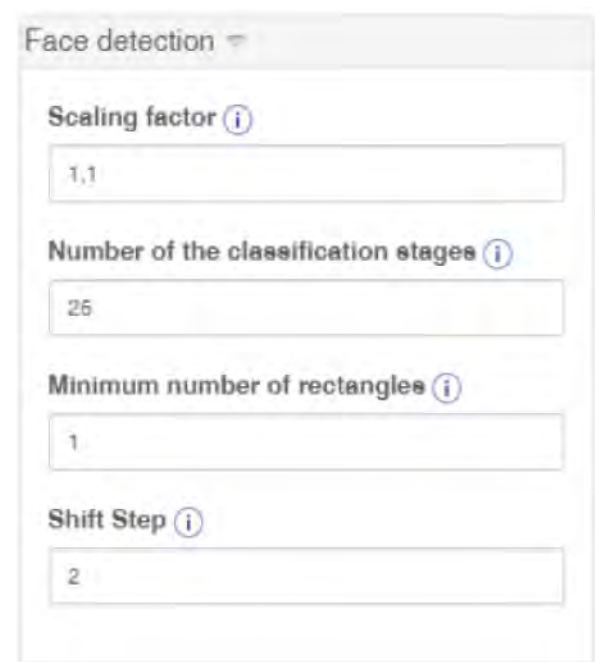
A configuration window titled "Face detection" with a dropdown arrow. It contains four settings, each with a label, an information icon (i), and a text input field. The first setting is "Scaling factor" with a value of "1,1". The second is "Number of the classification stages" with a value of "26". The third is "Minimum number of rectangles" with a value of "1". The fourth is "Shift Step" with a value of "2".

Fig. 9: AI-BIO Face detection

**Scaling factor:** Growing factor of the window for the face detection (default 1,1). By increasing the value of this parameter (max 2,0) you will make the algorithm faster but on the other hand it will became less sensible. Vice versa, by decreasing this value (min 1,01) the algorithm will become more sensible but also slower.



**Number of classification stages:** (default 25): Decreasing this value (it's suggested to not set it less than 18), the algorithm sensitivity is increased, but also the false positive rate is increased.

**Minimum number of rectangles:** Minimum number of rectangles to consider an object as a detected face (default 1 - maximum sensibility). Decreasing this value, the algorithm sensitivity is increased, but also increase the false positive (min 1) rate is increased. On the other hand, if this value is excessively increased, the miss rate may increase (it's suggested to not go further the value 10).

**Shift step:** Shift in pixels of the window for the face detection (default 2). Decreasing this value, the algorithm sensitivity and the processing time are increased (min 1). On the other hand, increasing this value, the sensitivity and the processing time may be reduced (it's suggested to not go further the value 10).

## Gaussian filtering

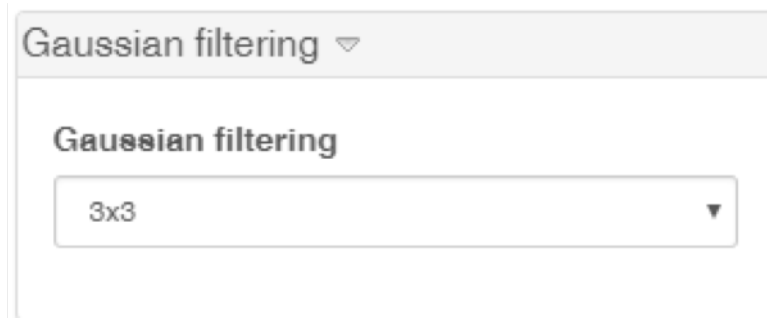


Fig. 10: Gaussian filtering

Image pre-processing by gaussian filtering eliminates the acquisition noise on the image and makes subsequent operations for object detection easier and more effective. The default kernel is 3x3, while other possible values are 5x5 and 7x7.

Gaussian filtering can also be deactivated.

## Background

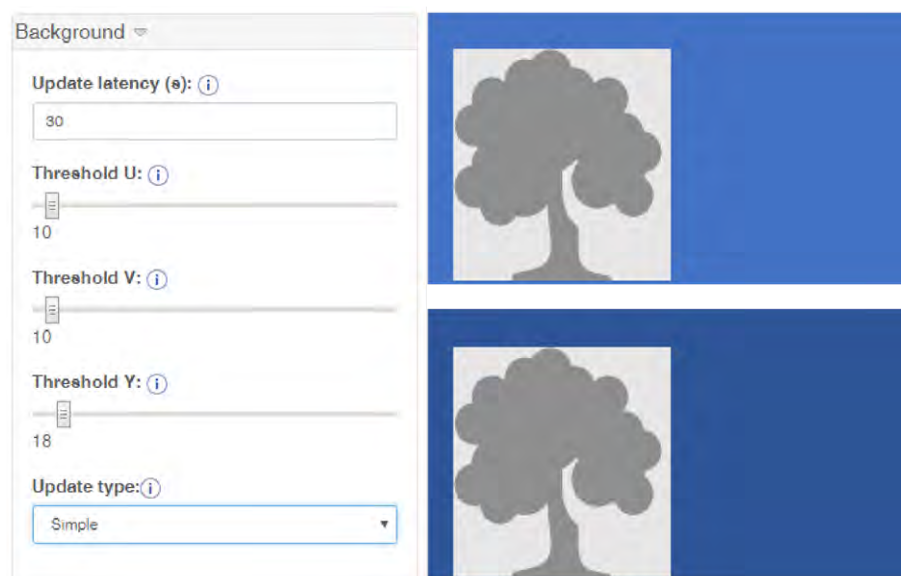


Fig. 11: Background

The background settings allow modeling and updating the background by setting the entry time of an object in the background

The output is an image in the YUV420 color space which represents the static part of the scene shot; it is then used to determine the dynamic part of the current frame, that is the foreground mask.

**Update latency (s):** Time period in seconds after a change in the scene must definitely become part of the background

**Threshold (YUV):** A comparison is made between the current frame and the background image of the previous instant: if the pixel of the frame is "close" to the corresponding pixel of the background, then it is not a foreground pixel; otherwise, that pixel will be white in the foreground mask. The comparison is made separately on each of the three YUV channels

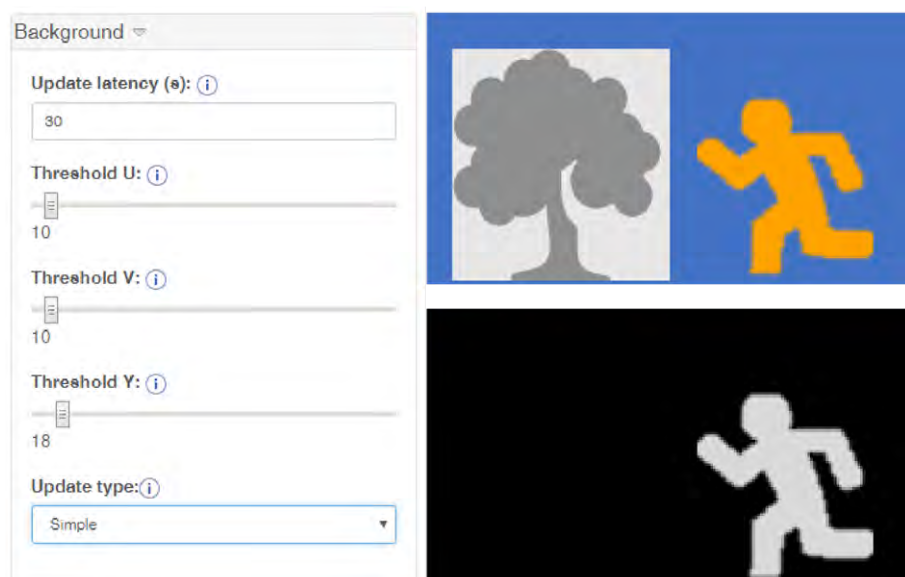


Fig. 12: Example background extraction using a threshold for each of the three YUV channels.

**Update type:** By specifying «Accurate (grayscale)» or «Accurate (color)» as background update type, it is possible to use a state of the art self learning algorithm for extracting the foreground mask. The «grayscale» version uses only the Y color channel, while the «color» version uses all the channels; of course, the first is more efficient, while the second is more effective. Moreover, the shadow removal can be enabled only with the color version.

## Morphological filtering

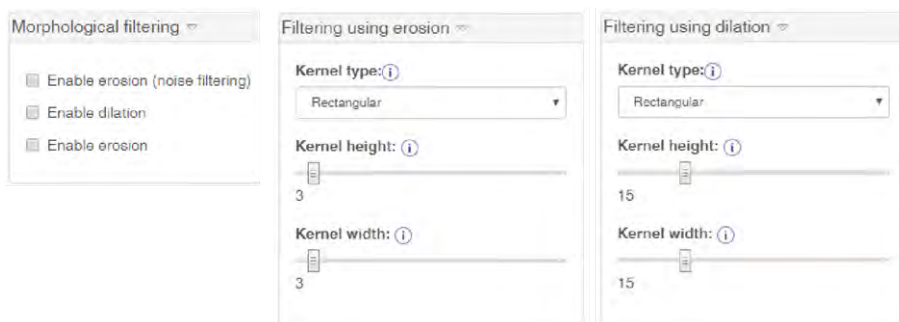


Fig. 13: Morphological filtering

Application of morphological erosion, dilation and another erosion operators to improve the foreground mask

**Enable erosion (noise filtering):** eliminates the spurious white pixels caused by noise

**Enable dilation:** fills holes and reinforces the union of weakly connected regions.

**Enable erosion:** allows to recover the original size of the objects.

It is possible to choose the shape of the kernel to be used (rectangular, diamond, octagon, disk), as well as the dimension in terms of width and height (rectangular) or radius (diamond, octagon, disk).

## Tracking (AI-BIO, AI-SECURITY only)

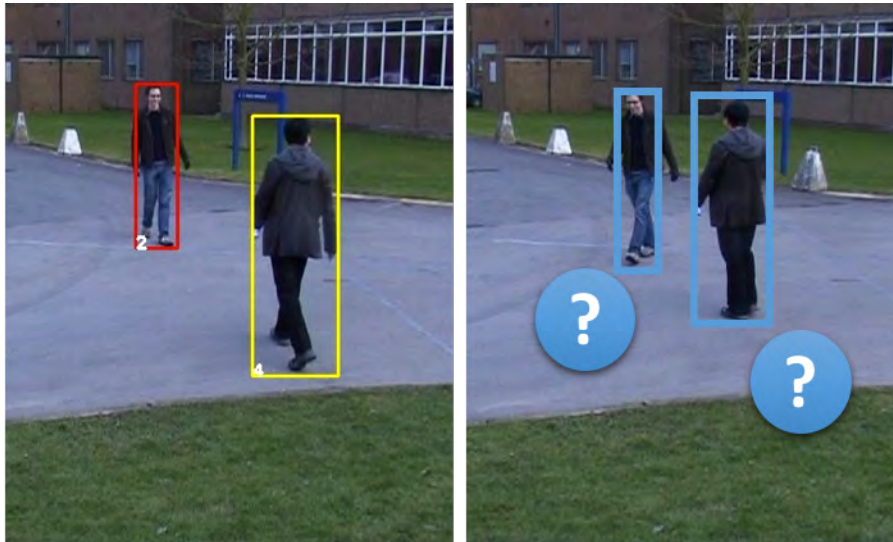


Fig. 14: Object tracking

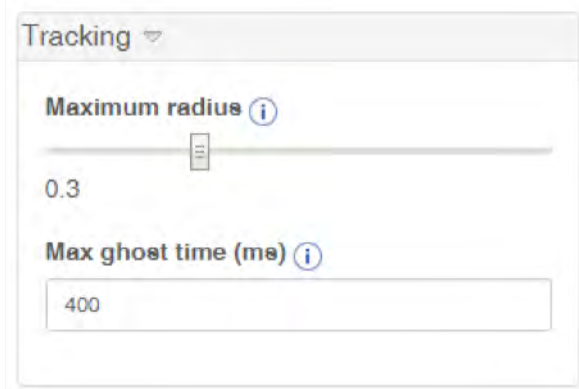


Fig. 15: Tracking (AI-BIO and AI-SECURITY only)

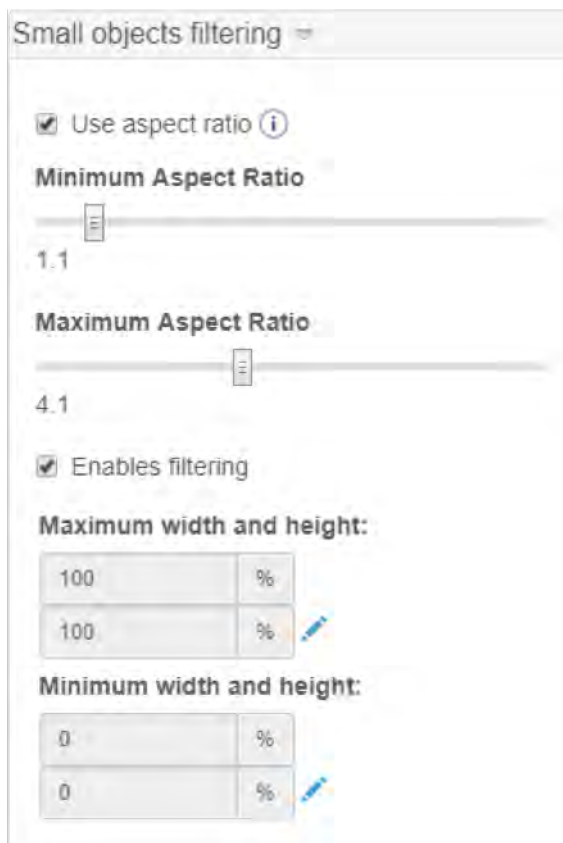
Tracking of objects in different frames depending on the position in the image

The objective is to find the correspondence between the detected object to the preceding frame (t-1) and the blob identified at the current frame (t), solving, in this way, problems related to occlusions (for example trees)

**Maximum radius:** Maximum movement of an object between two successive frames. A too small value may cause frequent switches of the ID, while a too large value may cause the assignment of the same ID to different objects. The value is expressed as a fraction of the frame diagonal.

**Max ghost time (ms):** Maximum time (in milliseconds) for which a detected object can assume the status of ghost, namely it can be stored and retrieved in case of occlusion.

## Small objects filtering (AI-SECURITY only)



The screenshot shows a configuration panel titled 'Small objects filtering'. It contains the following settings:

- ☒ Use aspect ratio ⓘ
- Minimum Aspect Ratio**: A slider set to 1.1.
- Maximum Aspect Ratio**: A slider set to 4.1.
- ☒ Enables filtering
- Maximum width and height:**
  - Width: 100 %
  - Height: 100 %
- Minimum width and height:**
  - Width: 0 %
  - Height: 0 %

Fig. 16: Small objects filtering (AI-SECURITY only)

Elimination of blobs that are too small, too large or abnormally shaped based on pixel dimensions

**Use aspect ratio:** Check to activate the aspect ratio settings. The settings allow to detect, for example, only people or just cars.

**Minimum Aspect Ratio:** define the minimum value of the relationship between height and width.

**Maximum Aspect Ratio:** define the maximum value of the relationship between height and width.

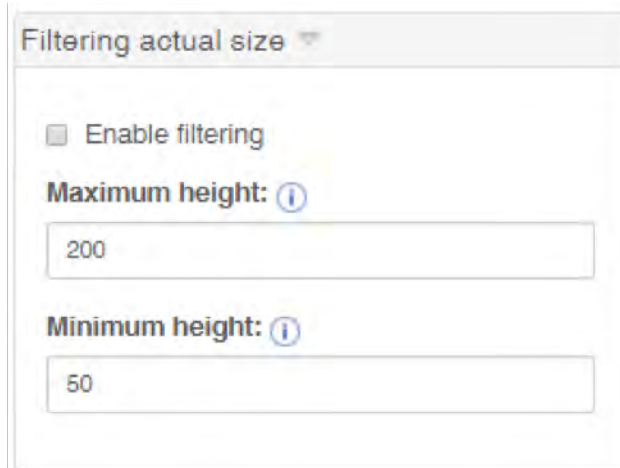
**Enable filtering:** Check to activate the filtering settings. You can define minimum and maximum values for the height and width of a blob by drawing a couple of rectangles on the image.

**Maximum width and height:** define the maximum value of the object size.

**Minimum width and height:** define the minimum value of the object size.

## Filtering actual size (AI-SECURITY only)

To use this filter it is necessary first to calibrate the camera and the algorithm, to be able to calculate the relation that allows to deduce the real dimensions of an object starting from the pixel dimensions (see [Camera Calibration \(AI-SECURITY only\)](#), p. 21)



Filtering actual size

☐ Enable filtering

Maximum height: ⓘ

200

Minimum height: ⓘ

50

Fig. 17: Filtering actual size (AI-SECURITY only)

This filter allows the elimination of blobs that are too short or too tall based on actual size

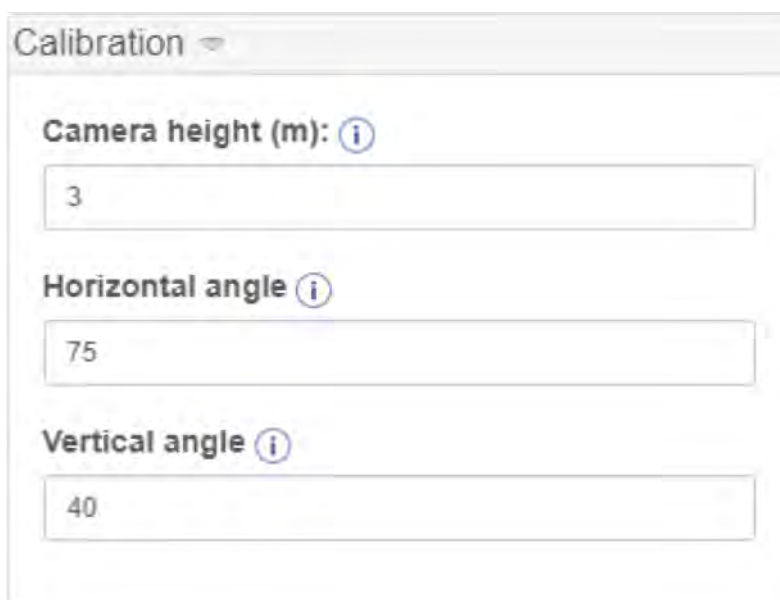
**Enable filtering:** Check to activate the filtering settings. You can define minimum and maximum values for the height and width of a blob.

**Maximum height:** define the maximum height of a blob.

**Minimum height:** define the minimum height of a blob.

## Camera Calibration (AI-SECURITY only)

The camera calibration has to be done before filtering the actual size (see [Filtering actual size \(AI-SECURITY only\)](#), p. 20)



Calibration

Camera height (m): ⓘ

3

Horizontal angle ⓘ

75

Vertical angle ⓘ

40

Fig. 18: Camera Calibration (AI-SECURITY only)

This filter allows the elimination of blobs that are too short or too tall based on actual size.

**Camera height (m):** mounting height of the camera in meters.

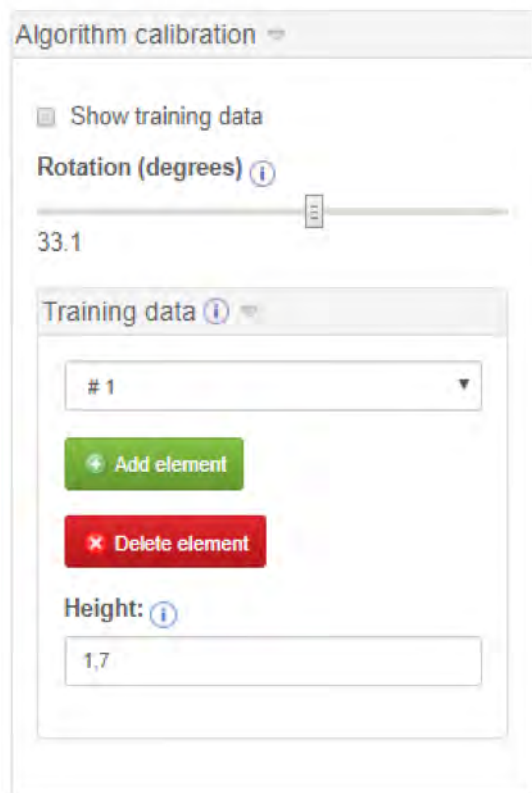
**Horizontal angle:** cameras horizontal angle of view in degree. It is available on the datasheet of a fixed focal cameras, to be calculated for varifocal cameras.

**Vertical angle:** cameras vertical angle of view in degree. It is available on the datasheet of a fixed focal cameras, to be calculated for varifocal cameras.

## Algorithm parameters (AI-SECURITY) only

### Algorithm calibration

Algorithm calibration provides a collection of samples to train an algorithm that calculates the actual dimensions from those in pixels



Algorithm calibration

☐ Show training data

Rotation (degrees) i

33.1

Training data i

# 1

+ Add element

x Delete element

Height: i

1,7

Fig. 19: Algorithm calibration (AI-SECURITY only)

This filter allows the elimination of blobs that are too short or too tall based on actual size.

**Show training data:** Check to show training data in the preview image.

**Rotation (degrees):** Camera rotation in reference to the horizontal plane.

**Add element:** ask a person of known height to move in different positions in the scene and at different distances from the camera. Drawing a rectangle around the person every time he stops.

**Delete element:** Click to delete the selected element.

**Height (m):** Height of the element in meters.

### Shadow removal(AI-SECURITY only)

The algorithm for shadow removal is based on the analysis of the chromaticity difference between the background and the current frame, since the shadows typically make the pixels darker.

Shadow removal ▾

☒ Enable shadow removal

Min fg-to-bg brightness ratio ⓘ

0.69

Max fg-to-bg brightness ratio ⓘ

1

Max Hue difference ⓘ

100

Max saturation increase ⓘ

19

Fig. 20: Shadow removal (AI-SECURITY only)

**Enable shadow removal:** Check to activate the shadow removal settings.

**Min fg-to-bg brightness ratio:** Decreasing this value means the algorithm gets mor sensitive.

**Max fg-to-bg brightness ratio:** Increasing this value means the algorithm gets mor sensitive.

**Max hue difference:** Increasing this value means the algorithm gets mor sensitive and therefore removes also strong shadows.

**Max saturation increase:** Increasing this value means the algorithm gets mor sensitive and therefore removes also strong shadows.

## Brightness control

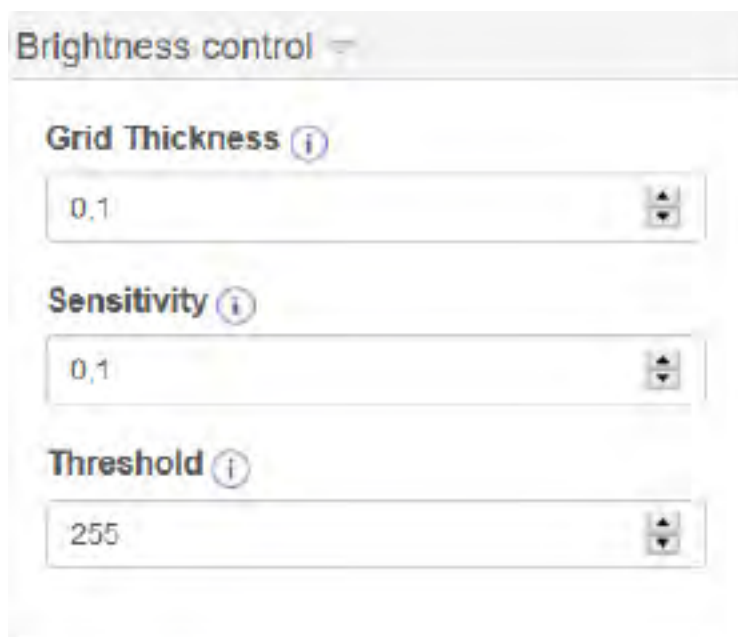
The screenshot shows a panel titled "Brightness control" with a minus icon. It contains three settings: "Grid Thickness" with a value of 0,1, "Sensitivity" with a value of 0,1, and "Threshold" with a value of 255. Each setting has an information icon (i) and a vertical slider control.

Fig. 21: Brightness control

When sudden changes in brightness occur in the scene, the difference between the current frame and the background instantly becomes very high, generating a lot of noise on the foreground mask. The detection of this abnormal situation allows application to stop for a few moments the processing, allowing the background to automatically adapt to the brightness of the scene change.

For efficiency reasons the algorithm works on a grid built on the image and evaluates the differences in brightness only in grid intersections.

## Performance

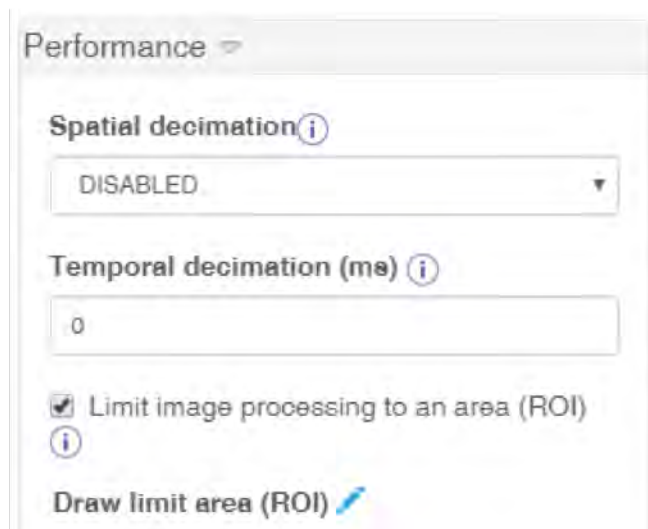
The screenshot shows a panel titled "Performance" with a minus icon. It contains three settings: "Spatial decimation" set to "DISABLED", "Temporal decimation (ms)" set to 0, and a checked checkbox "Limit image processing to an area (ROI)". Below the checkbox is an information icon (i) and a button "Draw limit area (ROI)" with a pencil icon.

Fig. 22: Performance

Performance optimizations to make the algorithms more efficient.



**Spatial decimation:** consists in reducing the resolution at which the algorithm processes images. It is possible to reduce the size by a factor of 2 or 4, processing an image that is respectively a quarter or a sixteenth compared to the initial one.

**Temporal decimation:** allows to "discard" some frames, processing a picture every K milliseconds.

**ROI:** allows to perform the image processing only in the region drawn by the user.

## Blob detection (AI-SECURITY only)

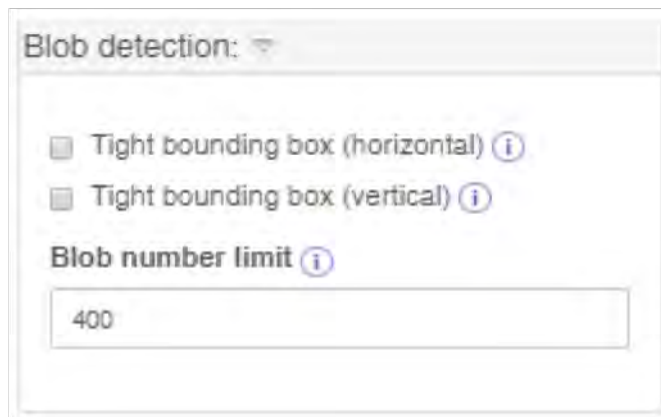
The screenshot shows a configuration panel titled "Blob detection:". It contains two checkboxes: "Tight bounding box (horizontal)" and "Tight bounding box (vertical)", both of which are currently unchecked. Below these is a label "Blob number limit" followed by a text input field containing the value "400". Each label and checkbox has a small circular information icon (i) to its right.

Fig. 23: Blob detection (AI-SECURITY) only

**Tight bounding box (horizontal):** consists in reducing the horizontal dimension of the bounding box by centering it with respect to the centroid.

**Tight bounding box (vertical):** consists in reducing the vertical dimension of the bounding box by centering it with respect to the centroid.

**Blob number limit:** allows to limit the number of blobs detected by the plugin in a single frame.

## Stream

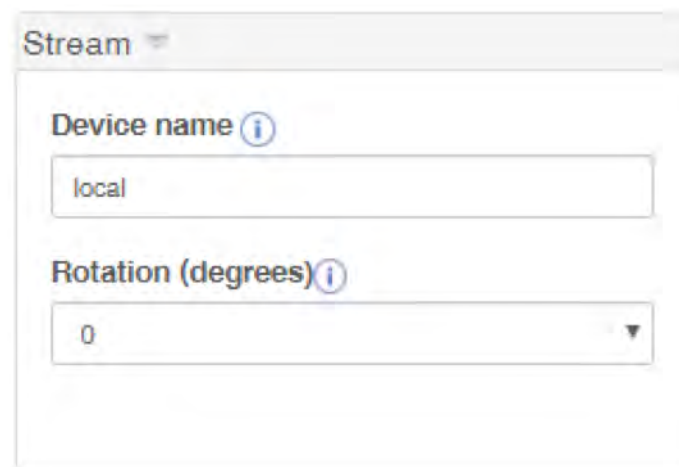
The screenshot shows a configuration panel titled "Stream". It contains two fields: "Device name" with a text input field containing the value "local", and "Rotation (degrees)" with a dropdown menu currently showing "0". Each label has a small circular information icon (i) to its right.

Fig. 24: Stream

Ability to process a rotated image compared to that acquired by the camera. This operation, however, it may be interesting in the case where, for example, you want to install a camera in portrait mode, so as to take advantage of the horizontal opening angle of the camera to frame a person standing.

**Device name:** change the name of the stream

**Rotation (degrees):** image can be rotated by 90 °, 180 ° and 270 °.

## Event notification

All AI-Apps can notify each event simultaneously to multiple recipients. You can enable and configure each recipient in the specific section of the events panel.

You can also specify for each event the channel on which you want to be notified. In the configuration section it is possible to enable the sending of only the desired events. This way you can completely customize the events sending. You can choose which event to send for each channel.

### AI-RETAIL Events

**Counting event** is generated every time a person crosses a people counting sensor. The event gives information about the number of persons which crossed the sensor simultaneously and related to the total number of crossings counted by the sensor since the last reset. It can be sent with and without images.

**Aggregate event** is generated when the number of persons (IN-OUT) is greater than a threshold configured by the user. Such event can be used as an alarm or like an advertisement of overcrowding, in case of a single entrance/exit gate. It can be sent with and without images.

**Crowd event** is generated periodically, with a period specified by the user during plugin configuration, giving an estimation of the average number of persons in the considered period. Such event can be used for collecting statistics about the retail shop. It can be sent ONLY without images.

**Overcrowd event** is generated when the estimated number of persons in the sensor is greater than a threshold configured by the user. Such event can be used as an alarm or like an advertisement of overcrowding. It can be sent with and without images.

**Test event** is generated by the user, clicking on the specific button on AI-Config. It can be used to verify the communication with the event collectors.

### AI-BIO Events

**Bio event** is generated when a person, which face has been detected, leaves the scene. The event gives information about the gender, the age category and the persistence time of each person in front of the camera. It can be sent with and without images.

**Digital\_Signage event** is generated when persons are detected in front of the camera, after a minimum period of persistence. The event gives information about the average gender and age of the persons . It can be sent with and without images.

**Test event** is generated by the user, clicking on the specific button on AI-Config. It can be used to verify the communication with the event collectors.

### AI-SECURITY Events

**Sterile\_Zone** is generated when an intruder persists in a sterile zone. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Crossing\_Line event** is generated when an object crosses a line. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Intrusion\_Pro event** is generated when an object crosses a multiple line. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Lost event** is generated when an object is abandoned or removed in a lost sensor. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Loitering event** is generated when a loitering behavior is detected in a loitering sensor. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Test event** is generated by the user, clicking on the specific button on AI-Config. It can be used to verify the communication with the event collectors.

## AI-TRAFFIC Events

**Sterile\_Zone** is generated when an intruder persists in a sterile zone. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Crossing\_Line event** is generated when an object crosses a line. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Intrusion\_Pro event** is generated when an object crosses a multiple line. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Lost event** is generated when an object is abandoned or removed in a lost sensor. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Loitering event** is generated when a loitering behavior is detected in a loitering sensor. The event gives information about the position of the object which generated the alarm. It can be sent with and without images.

**Test event event** is generated by the user, clicking on the specific button on AI-Config. It can be used to verify the communication with the event collectors.

## Image saving options

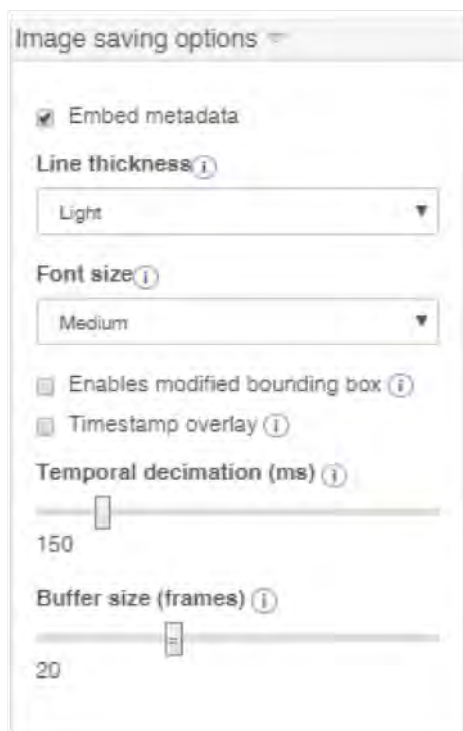


Image saving options

☒ Embed metadata

Line thickness ⓘ

Light

Font size ⓘ

Medium

☐ Enables modified bounding box ⓘ

☐ Timestamp overlay ⓘ

Temporal decimation (ms) ⓘ

150

Buffer size (frames) ⓘ

20

Fig. 25: Images saving options

**Embed metadata:** activate to enable the sending of annotated images (with sensors and bounding boxes for example) associated to the events.

**Line thickness:** specify the thickness of bounding boxes and the font size of the superimposed strings.

**Font size:** specify the font size of the superimposed strings.

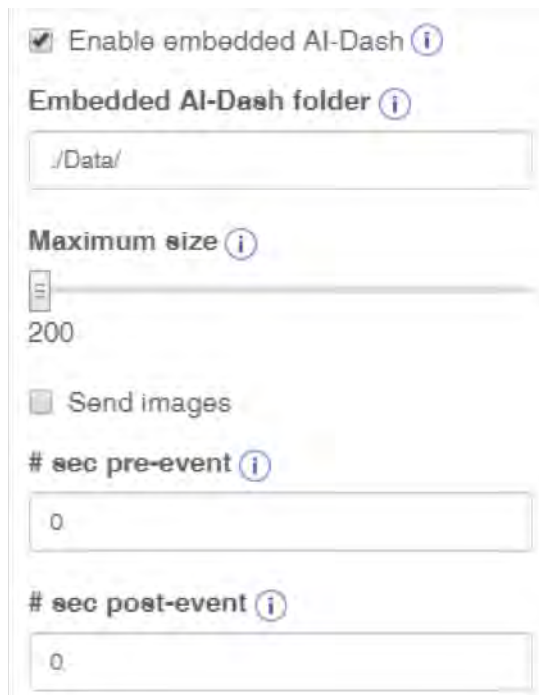
**Modified bounding box:** when enabled a bounding box is drawn, which allows to observe the object orientation in the image.

**Timestamp overlay:** shows the date and hour overlay on the top right of the image.

Finally, since many event managers allows to send images in a time interval pre and post event, it is possible to specify the buffer size in frames and the time interval between consecutive frames saved in the buffer.

**ATTENTION** – The **buffer size** configuration and the **temporal decimation** with whom the frames are stored impose a limit on the number to PRE and POST seconds of images that can be associated to the events

## Embedded AI-Dash



The screenshot shows a configuration panel for 'Embedded AI-Dash'. It includes a checked checkbox for 'Enable embedded AI-Dash', a text field for 'Embedded AI-Dash folder' containing '/Data/', a slider for 'Maximum size' set to 200, an unchecked checkbox for 'Send images', and two text input fields for '# sec pre-event' and '# sec post-event', both containing '0'. Each field has an information icon (i) to its right.

Fig. 26: Embedded AI-Dash

**Enable AI-Dashboard embedded:** activate to send events to AI-Dashboard embedded.

**Embedded AI-Dash folder:** folder in which the AI-Dashboard embedded database is created.

**Maximum size:** maximum size (in MB) that AI-Dashboard embedded can occupy on the device.

**Send images:** activate to send event images to AI-Dashboard embedded database

**# Sec pre-event:** Number of seconds of images before event.

**# Sec post-event:** Number of seconds of images after event.

External AI-Dash

Sending event to AI-Dash

☒ Enable sending events

IP: 

1.1.1.1

Port: 

8080

AI-Dash ID 

default

☐ Send images

# sec pre-event 

0

# sec post-event 

0

☐ Backward compatibility with AI-Dash

Fig. 27: External AI-Dash

**Enable send sending events:** activate to send events to external AI-Dash.

**IP:** IP address of the server on which AI-Dash is installed (both server version and a cloud version).

**Port:** Port on which AI-Dash listens.

**AI-Dash ID:** Once created on AI-Dash PRO the identifier related to your site and company, you can insert it in this field. For more detail, please refer to the documentation of AI-Dash PRO.

**Backward compatibility with AI-Dash:** Enable this field if you have AI-Dash and not the new AI-Dash PRO (for more details please refer to the custom server notification in the following).

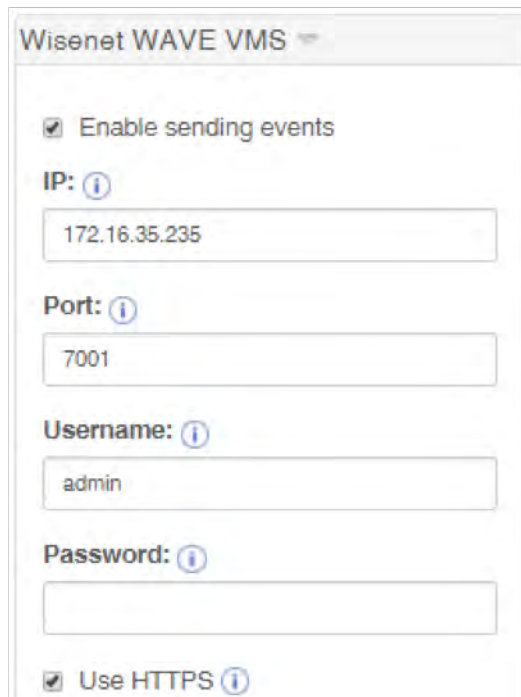
**Send images:** activate to send event images to AI-Dash database

**# Sec pre-event:** Number of seconds of images before event.

**# Sec post-event:** Number of seconds of images after event.

ATTENTION! To receive events, it may be necessary to disable the firewall

## Wisenet WAVE



The screenshot shows a configuration window titled "Wisenet WAVE VMS". It contains several settings:

- ☒ Enable sending events
- IP:**  (with an information icon)
- Port:**  (with an information icon)
- Username:**  (with an information icon)
- Password:**  (with an information icon)
- ☒ Use HTTPS (with an information icon)

Fig. 28: Wisenet WAVE

**Enable send sending events:** activate to send events to Wisenet Wave.

**IP:** IP address of Wisenet WAVE VMS.

**Port:** Port number of the Wisenet WAVE VMS.

**Username:** Username to authenticate the Wisenet WAVE VMS.

**Password:** Password to authenticate to the Wisenet WAVE VMS.

**Use HTTPS:** activate to send events through https

The event sending to Wisenet WAVE is not supported for Crowd events

## Hanwha SSM

Hanwha SSM

☒ Enable sending events

IP: i

192.168.1.100

Port: i

9999

Device GUID i

af4eeef0-a33a-4c30-9dc8-24dbd1694039

Event Code i

4000

Set the server timezone i

+0200

**Fig. 29: Hanwha SSM**

**Enable send sending events:** activate to send events to Hanwha SSM.

**IP:** IP address of the server on which SSM is installed

**Port:** Port number of the SSM.

**Device GUID:** device identifier to read on SSM.

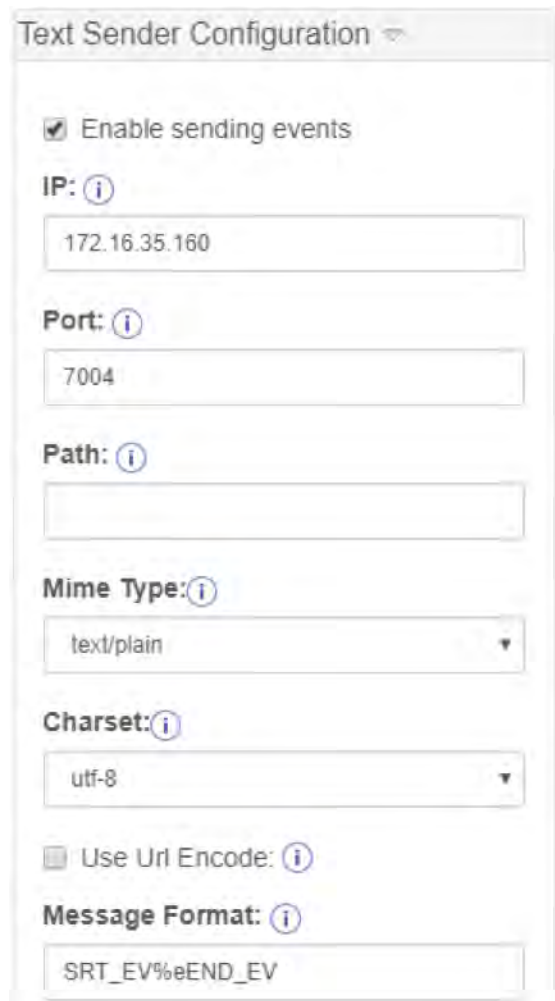
**Set the server timezone:**SSM server timezone.

The sending of events to Wisenet SSM is not supported for Crowd events.

## Text Sender Configuration

This mechanism makes the app integrated with the Wisenet NVR.





The image shows a 'Text Sender Configuration' form. It includes a checkbox for 'Enable sending events' which is checked. Below this are input fields for 'IP' (containing '172.16.35.160'), 'Port' (containing '7004'), and 'Path' (empty). There are dropdown menus for 'Mime Type' (set to 'text/plain') and 'Charset' (set to 'utf-8'). A checkbox for 'Use Url Encode' is unchecked. The 'Message Format' field contains the text 'SRT\_EV%eEND\_EV'. Each field has an information icon (i) next to its label.

Fig. 30: Text sender configuration

**Enable send sending events:** activate to send events.

**IP:** IP address of the server on which AI-Dash is installed in both the server version and a cloud version.

**Port:** Port number.

**Path:** Path for the POST to the receiving server;

**MIME type:** MIME Type with which the message will be transmitted.

**charset:** Character set for the message text.

**Use URL Encode:** indicates that the message is encoded using URL Encode for sending.

**Message Format:** message text sent to the server. These placeholders can be used in the message text

- **event name:** %e
- **device name:** %d
- **sensor name:** %s
- **date:** %t (format DD / MM / YYYY)

**Use URL Encode:** indicates that the message is encoded using URL Encode for sending.

The sending of text events is not supported for Crowd events.

## Digital output

Digital Output

☒ Enable sending events

Pulse Duration (ms):

500

Inter Pulse Time (ms):

200

Number of pulses:

1

Device

Samsung

Pin

Default Port

Fig. 31: Digital output

**Enable send sending events:** activate to send event via a digital output.

**Single pulse duration (ms):** duration of a single pulse in milliseconds.

**Pulse Interval (ms):** Time in ms between two pulses.

**Number of pulses:** Number of pulses sent through the alarm out port.

**Device:** Device on which the application is running.

**Pin:** Pin you want to use on the device.

Sending of events to digital inputs is not supported for Crowd events.

## HTTP I/O

HTTP I/O

☒ Enable sending events

IP:

Port:

Path:

Username:

Password:

Parameters:

☐ Use HTTPS

Fig. 32: HTTP I/O

**Enable send sending events:** activate to send event via generic I / O (for example to call the CGIs of the Wisenet NVR).

**IP:** IP address of the remote I / O.

**Port:** port on which is listening on the remote I / O.

**Path:** Path of the remote I / O.

**Username:** user name to connect to the remote I / O.

**Password:** Password to connect to the remote I / O.

**Parameters:** query string with all the required parameters. The format allows to add information about the event. It's necessary to add the following tags to the message

- **event name:** %e
- **device name:** %d
- **sensor name:** %s
- **date:** %t (format DD / MM / YYYY)

**Use HTTPS:** : if checked, send through HTTPS.

example to set 10 seconds of duration of an alarm on the Hanwha NVR by using Hanwha SUNAPI:  
http://172.16.35.160/stw-cgi/io.cgi?m-sub-menu-u=alarmoutput&action=set&AlarmOutput.1.IdleState=NormallyOpen&AlarmOutput.1.ManualDuration=10s

## Sending event to E-mail

Sending event to E-mail

☒ Enable sending events

Sender

test@site.com

Username:

test@site.com

Password:

\*\*\*\*\*

SMTP Server

smtp.site.com

SMTP port

587

Recipients:

test@site.com

# sec pre-event

0

# sec post-event

0

**Fig. 33: Sending event to E-mail**  
**Enable send sending events:** activate to send event via email.  
**Sender:** e-mail address of the sender.  
**Username:**sender's user name for SMTP server access.

**Password:** sender's password for SMTP server access.

**SMTP Server:** address of the SMTP server.

**SMTP port:** port number of the SMTP server.

**Recipients:** You can enter multiple email addresses separated by a semicolon.

**# Sec pre-event:** Number of seconds of images before event.

**# Sec post-event:** Number of seconds of images after event.

The sending of events by e-mail is not supported for Crowd events

## Sending event to Milestone

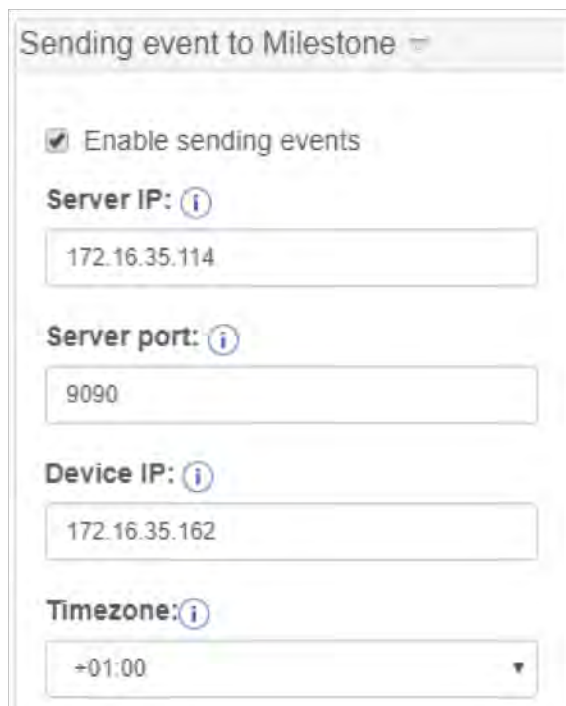


Fig. 34: Sending event to Milestone

**Enable send sending events:** activate to send event to Milestone XProtect®

**IP server:** IP address of the server on which you installed Milestone XProtect®, both server version and a cloud version.

**Server port:**Port number to listen for Milestone XProtect® events.

**IP device:** IP address of the device.

**Timezone:** Timezone of Milestone XProtect® servers.

The sending of events to Milestone XProtect® is not supported for Crowd events.

## Sending event to Artecó EVERYWHERE

Sending event to Artecó EVERYWHERE

☒ Enable sending events

IP:

192.168.1.100

Port:

80

Username:

username

Password:

\*\*\*\*\*

Output number

1

Fig. 35: Sending event to Artecó EVERYWHERE

- Enable send sending events:** activate to send event to Artecó EVERYWHERE.
- IP:** IP address of the server on which you installed Milestone Artecó EVERYWHERE, both server version and a cloud version.
- Server port:** Port number to listen for Artecó EVERYWHERE.
- Username:** Username for login to Artecó EVERYWHERE server.
- Password:** Password for login to Artecó EVERYWHERE server.
- Number of output:** Output number associated with the event.

The sending of events to Artecó EVERYWHERE is not supported for Crowd events.

## Sending event to Artec NEXT

Sending event to Artec NEXT

☒ Enable sending events

IP: ⓘ  
1.1.1.1

Port: ⓘ  
80

Path: ⓘ  
/arteco-mobile/event.fcgi

Username: ⓘ  
xxxx

Password: ⓘ  
\*\*\*\*

Connector ID: ⓘ  
162

Camera ID: ⓘ  
333

Description: ⓘ

Fig. 36: Sending event to Artec NEXT

**Enable send sending events:** activate to send event to Artec NEXT.

**IP:** IP address of the server on which you installed Milestone Artec NEXT, both server version and a cloud version.

**Server port:** Port number to listen for Artec NEXT server.

**Username:** Username for login to Artec NEXT server.

**Password:** Password for login to Artec NEXTserver.

**Connector ID:** Identification of the connector defined in Artec NEXT for sending event notifications.

**Camera ID:** Identification of the connector defined in Artec NEXT for sending event notifications.

**Description:** Information that will be displayed in Artec NEXT related to the application of video analysis.

The sending of events to Artec NEXT is not supported for Crowd events.

## Sending event to Avigilon POS

Avigilon

☒ Enable sending events

Port: ⓘ

Beginning event string ⓘ

Ending event string ⓘ

Fig. 37: Sending event to Avigilon POS

**Enable send sending events:** activate to send event to Avigilon POS.

**Port:** Port number on which the Avigilon server is listening.

**Beginning event string:** characters at the beginning of the event.

**Ending event string:** characters at the end of the event.

The sending of events to Avigilon POS is not supported for Crowd events.



## Sending event to FTP server

Sending to FTP server

☒ Enable sending events

File name prefix ⓘ

cf

IP: ⓘ

192.168.0.1

Port: ⓘ

21

Username: ⓘ

user

Password: ⓘ

\*\*\*\*\*

Target Path ⓘ

/Documents/FTP\_TEST/

☒ Send images ⓘ

Fig. 38: Sending event to FTP server

**Enable send sending events:** activate to send event to a FTP server.

**IP:** IP address of the FTP server.

**Port:** port number of the FTP server.

**Username:** Username to authenticate to the FTP server.

**Password:** Password to authenticate to the FTP server.

**Path of destination:** Path, defined from the root folder, FTP, to transfer the files to the server.

**Send images:** check to include images in the event sent.

Remote server

Remote Server ▾

☒ Enable sending events

IP: ⓘ

Port: ⓘ

Path: ⓘ

☐ Send json as "form-data" ⓘ

☒ Send images ⓘ

# sec pre-event ⓘ

# sec post-event ⓘ

☐ Backward compatibility with AI-Dash ⓘ

Fig. 39: Sending event to Remote server

- Enable send sending events:** activate to send event to remote server.
- IP Server:** IP address of the remote server.
- Port:** port number of the remote server.
- Path:** Path for the POST to the receiving server.
- Send json as “form-data”:** Enables url encoding for the message sent.
- Send images:** check to include images in the event sent.
- # Sec pre-event:** Number of seconds of images before event.
- # Sec post-event:** Number of seconds of images after event.
- Backward compatibility withAI-Dash:** Enable this field if you want to receive events compliant with AI-Dash and not the new AI-Dash PRO (for more details please refer to the custom server notification in the following).

Input by web request

The event notification triggering through web request event\_switch.cgi is available for all applications on all

platforms.

Input by web request ▾

☒ Use event activation/deactivation via web request ⓘ

Password ⓘ

☒ Events initially enabled ⓘ

Behaviour ⓘ

Timed ▾

Switch duration (ms) ⓘ

5000

Fig. 40: Input by web request

**Use event activation/deactivation via web request:** activate to manage the input via web request.

**Password:** Required to avoid fraudulent activation/deactivation.

**Events initially enabled:** If enabled, the events are initially activated and in presence of web inputs are inhibited. Otherwise, events are initially inhibited and will be activated in presence of web inputs.

**Behaviour:** Possible values are: timed or on/off. An on/off input enables/disables the sending of events on the rising edge. A time input enables / disables the sending of events for a certain time interval, specified by the "Switch duration" parameter.

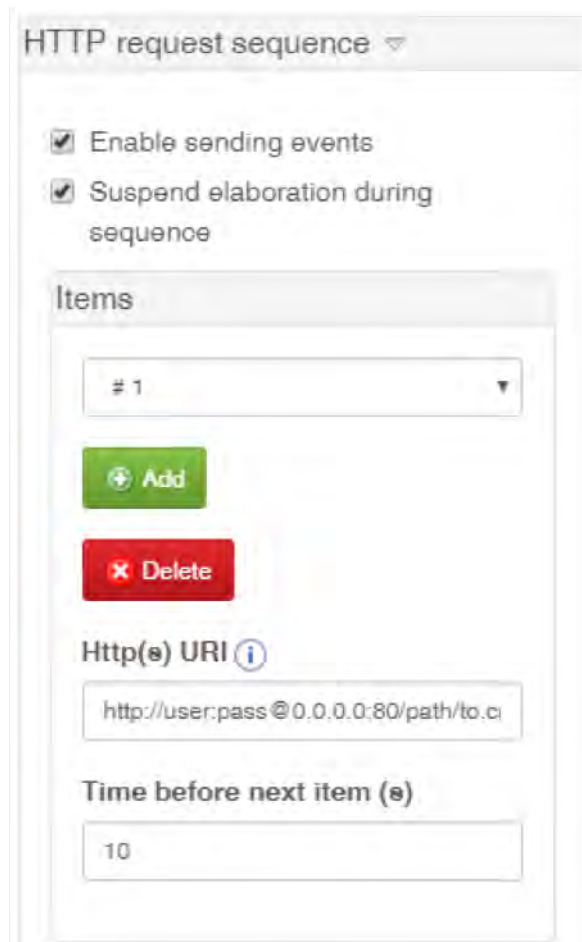
#### EXAMPLE:

disable events (because they are initially enabled) on a device with ip 192.168.1.1 and password «foo». If the behaviour is Timed, the events will be disabled for Switch duration ms

[http://192.168.1.1:8080/local/AIRetail3/event\\_switch.cgi?mode=toggle&password=foo](http://192.168.1.1:8080/local/AIRetail3/event_switch.cgi?mode=toggle&password=foo)

## HTTP request sequence

The plugin also allows to send sequences of HTTP requests, interspersed with a configurable time interval. As an example, you may think to move a PTZ camera on different presets or create your custom sequence to drive remote I/O devices. It is possible to configure an unlimited number of requests in the sequence.




HTTP request sequence ▾


☒ Enable sending events

☒ Suspend elaboration during sequence

Items

# 1 ▾

 Add

 Delete

Http(s) URI ⓘ

http://user:pass@0.0.0.0:80/path/to.c

Time before next item (s)

10

Fig. 41: Input by web request

**Enable sending events:** activate end events via HTTP request sequence.

**Suspend elaboration during sequence:** Enable it to suspend the elaboration during the sequence.

**Http(s) URI:** The path of the HTTP(s) request.

**Time before next item (s):** Time interval in seconds to call the next request in the sequence.

## Custom server compliant event notification

### Custom server compliant with AI-Dash

#### Events without images: POST with application/json

```
POST /pathOnServer HTTP/1.1
```

```
Accept: application/json
```

```
Host: 172.16.35.75:8080
```

Content-Type: application/json

Content-Length: 157

```
json_data:{"id_source": " people_sensor", "sensor_id": 4, "sensor_name":  
"S1", "event_type": "Counting", "mac_address": "b827ebc42838", "timestamp":  
1510761996, "actual_count": 35, "people_number": 1, "dash_id": "Site#Com-  
pany"}
```

## Events with images: POST with custom multipart/x-mixed-replace

POST /pathOnServer HTTP/1.1

Accept: \*/\*

Host: 172.16.35.75:8080

Content-length: 3844500

Content-Type: multipart/x-mixed-replace; boundary=gc0p4Jq0M2Yt08jU534c0p

--gc0p4Jq0M2Yt08jU534c0p

Content-Type: application/json

Content-Length: 157

```
{"id_source": " people_sensor", "sensor_id": 4, "sensor_name": "S1",  
"event_type": "Counting", "mac_address": "b827ebc42838", "timestamp":  
1510761996, "actual_count": 35, "people_number": 1, "dash_id": "Site#Com-  
pany"}
```

--gc0p4Jq0M2Yt08jU534c0p

Content-Type: image/jpeg

Content-length: 11146

JPEG DATA

...

## Custom server compliant with AI-Dash PRO

### Events without images: POST with application/json

```
POST /pathOnServer HTTP/1.1
```

```
Accept: application/json
```

```
Host: 172.16.35.75:8080
```

```
Content-Type: application/json
```

```
Content-Length: 157
```

```
{"id_source": " people_sensor", "sensor_id": 4, "sensor_name": "S1",  
"event_type": "Counting", "mac_address": "b827ebc42838", "timestamp":  
1510761996, "actual_count": 35, "people_number": 1, "dash_id": "Site#Com-  
pany"}
```

The headers are case insensitive as stated in HTTP standard. The number of images is variable. This value will be different based on images and event size. Note that the transfer encoding is set to chunked: HTTP 1.1 support is required. On the raw socket each chunk will follow a row with the number of bytes and followed by a new row.

See <https://tools.ietf.org/html/rfc7230#section-4.1> for details on chunked encoding.

See [https://www.w3.org/Protocols/rfc1341/7\\_2\\_Multipart.html](https://www.w3.org/Protocols/rfc1341/7_2_Multipart.html) for details on multipart/mixed content type.

### Events with images: POST with custom multipart/x-mixed-replace

```
POST /www/prova.php
```

```
HTTP/1.1Host: 172.16.35.28:80
```

```
Accept: tex-
```

```
t/htm-
```

```
1,application/json,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
```

```
User-agent: axia_http_client/2.6.1
```

```
Content-Type: multipart/mixed;boundary=gc0p4Jq0M2Yt08jU534c0p
```

```
Transfer-encoding: chunked
```

```
--gc0p4Jq0M2Yt08jU534c0p
```

```
Content-Disposition: form-data;
```

```
name="json"
```

```
Content-Type: application/json
```

```
Content-Length: 157
```

```
{"id_source": " people_sensor", "sensor_id": 4, "sensor_name": "S1",
"event_type": "Counting", "mac_address": "b827ebc42838", "timestamp":
1510761996, "actual_count": 35, "people_number": 1, "dash_id": "Site#Com-
pany"}
```

```
--gc0p4Jq0M2Yt08jU534c0p
```

```
Content-Disposition: form-data;
```

```
name="jpeg"
```

```
Content-Type: image/jpeg
```

```
Content-length: 60155
```

```
##### BINARY JPEG DATA (60155 bytes total) #####
```

```
--gc0p4Jq0M2Yt08jU534c0p--
```

## Custom server –JSON event format

JSON field	Value type	Description	Type of events
id_source	string	Name of the device, specified in the plugin configuration	All
event_type	string	Type of event. It can assume values: Counting, Aggregate, Crowd, Overcrowd	All
timestamp	string	Value which represents the number of seconds passed since 00:00 of the 1st January 1970 UTC (for instance, a Unix timestamp)	All
sensor_id	integer	Id associated to the sensor which generated the event	All
sensor_name	string	Name associated to the sensor which generated the event	All
mac_address	string	MAC address of the device that generated the event	All
dash_id	string	An identifier of the site and the company, specified in the plugin configuration	All

JSON field	Value type	Description	Type of events
people_number	integer	For Counting events, represents the number of persons crossing simultaneously the sensor. For Aggregate events, represents the current IN-OUT value. For Crowd and Overcrowd events, represents the number of estimated persons in the sensor.	All
actual_count	integer	For Counting events, represents the total number of persons counted by the sensor since the last reset. For Aggregate events, represents the current IN-OUT value.	Counting, Aggregate
period	integer	For Crowd events, interval between two consecutive events	Crowd

## AI-Dash - troubleshooting

In case of low bandwidth (e. g. because of huge network-load or undersized systems) or the camera is overloaded, the live screen may be loading slowly or not to show live. In addition, some browsers may activate filters that block streaming by default (usually Chrome, Firefox and Safari do not have locks).

In these cases:

- Reloading the page and wait for the live image
- Use a different web-browser

If image is displayed is green try to perform the following operations:

- Restart the cam, or alternatively reset to the initial settings (except those related to the application);
- Verify that the latest firmware is installed on the camera
- Contact technical support (see [Support](#), p. 5)



## AI-SECURITY

AI-SECURITY is a bundle including three different products, simultaneously installed on board of your camera.

- **AI-INTRUSION:** Intrusion detection in sterile zone and virtual line crossing
- **AI-LOST:** Abandoned or removed objects detection
- **AI-LOITERING:** Loitering detection in forbidden areas

## AI-SECURITY - camera positions

- Make sure the size of the target (person, object, animal, vehicle) is at least 10x10 pixels.
- If necessary, the camera should be mounted with external illuminators, to distinguish the targets with natural or artificial illumination.
- The camera should be mounted at a height between 3 and 5 meters
- The precision of the plugins can be reduced if there are occlusions, waving objects, vehicles which project light in interest areas and any other noise that continuously modifies the image

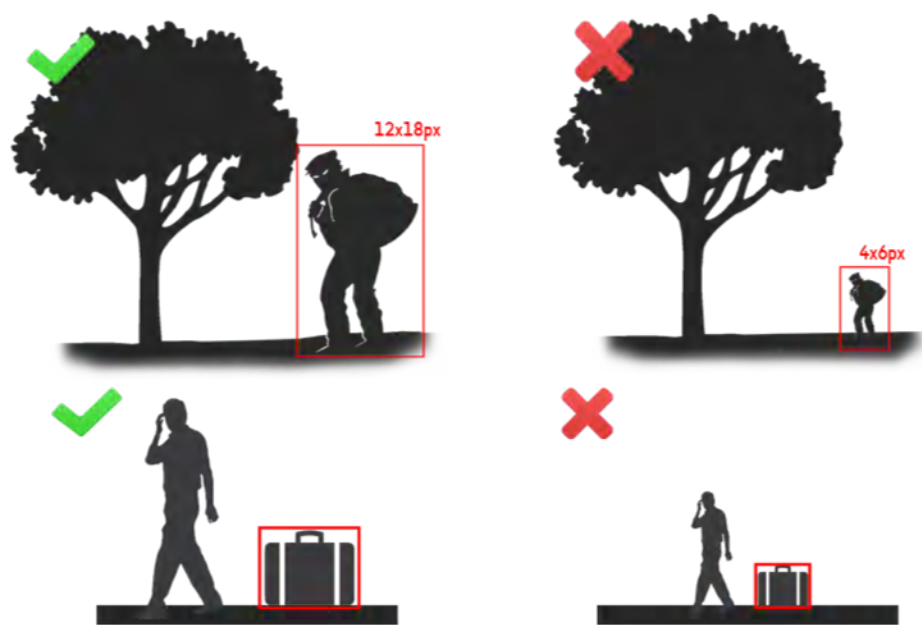


Fig. 42: Camera positions

# AI-INTRUSION

AI-INTRUSION is a video analytic app that is able to detect intruders in indoor and outdoor environments; thus, the environmental conditions will affect the performance of the application.

The accuracy to be expected is under ideal environmental and installation conditions

- Recall: 95%

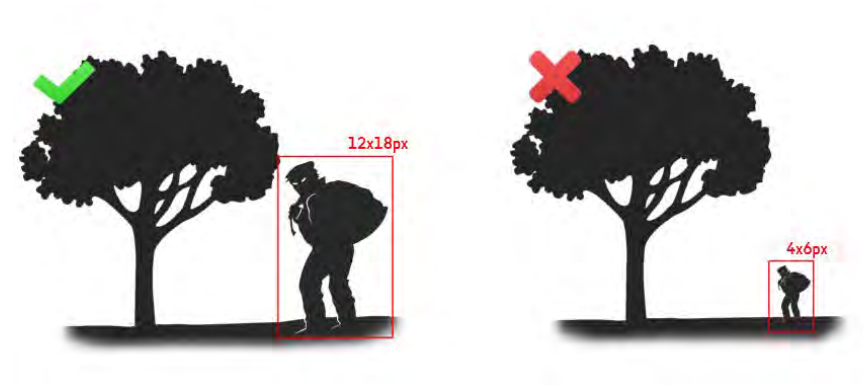


AI-INTRUSION

## Environment conditions


The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- Absence of stationary or slow-moving people for long periods in the counting area (e.g. Sales people that encourage customers to enter).
- There must be no fog, clouds or other moving objects whose appearance is similar to the target in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The people must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The target must stay in the interested area for a time of at least 1 second.  
The target must have a minimum area of 100 pixels.
- The target must move at a maximum speed of half their width on the image per frame. For example, a target that is 40 pixels wide at 10 frames per second must move at a speed of no more than 20 pixels per frame, that is 200 pixel per second.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- In case of thermal cameras, the image must be not coloured but in grayscale (white for "hot" pixels, black for "cold" pixels). The camera, thermal or monocular, must be always configured in order to avoid continuous changes of brightness.






AI-INTRUSION - target size


## Intrusion sensors


Intrusion sensors 


**Sensor color**






Intrusion sensors  


# 1 


 Add sensor

 Remove sensor

Redraw the sensor  

ID sensor 

1 

Sensor Name 

S1

Confidence:   
0.75Inhibition (s): 1 Latency alarm (s): 1 Sensors type Impulsive End time intrusion 1 

Fig. 43: Configuration of AI-INTRUSION Intrusion sensors

The configuration section provides the following functions:

**Add Sensor:** Click this button to draw the area of interest directly on the live image on the left. The area of interest it's a polygon with no limits to the number of sides.

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Redraw sensor:** Click this button to redraw the current sensor. The current area of interest will be deleted.

**ID sensor:** define a numeric ID for the sensor.

**Sensor name:** this name uniquely identifies the main counting sensor (green arrow); is used to generate counting events, sent, for example, to AI-Dash.

**Confidence:** A small value will make the algorithm very sensitive, instead with a value too large the algorithm could not generate the alarms.

**Inhibition (s):** Inhibition time in seconds of the sensor after an alarm has been generated. If an alarm is generated by the same sensor before the inhibition time is passed, it will be ignored by the system.

**Latency alarm (s):** Minimum intrusion time (seconds of permanence in the area of interest) before an alarm is generated. Time in seconds. Subjects who stay in the area of interest for less time than the set latency, won't generate any alarm.

**Sensor type:** there are two types of sensors:

- **Impulsive:** generates a single event for the whole duration of the intrusion.
- **Levels:** generates several types of event: beginning of the intrusion, intrusion continuation (every "Inhibition" seconds) and end of intrusion.

**End time intrusion:** after this amount of seconds, if none is in the level sensor, an event of "end of intrusion" will be sent.

## Crossing the line

Crossing the line

Sensor color

Crossing line sensors

# 1

Add sensor

Remove sensor

Redraw the sensor

ID sensor

2

Sensor Name

S2

Crossing line pre confidenza

0.1

Crossing line post confidence

0.5

Crossing line pre-latency

1

Crossing line post latency

1

**Fig. 44: Configuration of AI-INTRUSION Crossing line sensors**

The configuration section provides the following functions:

**Add Sensor:** Click this button to draw the area of interest directly on the live image on the left. The area of interest it's a polygon with no limits to the number of sides.

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Redraw sensor:** Click this button to redraw the current sensor. The current area of interest will be deleted.

**ID sensor:** define a numeric ID for the sensor.

**Sensor name:** this name uniquely identifies the sensor, it is used to generate events to be sent for example to AI-Dash.

**Crossing line pre confidence:** confidence relative to the object before it crosses the line ( pre alarm).

**Crossing line post confidence:** confidence relative to the activation of the alarm ( crossing the line) on a object already considered in a pre-alarm state.

**Crossing line pre latency:** time of latency of an object that is in the scene before it crosses the line (pre-alarm). Time in seconds.

**Crossing line post latency:** time of latency of an object already considered in pre-alarm state that it spends in the scene after it crosses the line. Time in seconds.

## Multiple crossing lines

A multiple crossing line sensor is an aggregate sensor inside the scene consisting of a set of crossing lines (see [Crossing the line, p. 55](#)). If the subject crosses all the lines specified in the scene, the alarm will be generated.



The screenshot shows a configuration window titled "Multiple crossing lines". It contains several sections for setting up sensors and their parameters.

- Sensor color:** A color selection bar with a red square selected.
- Multiple crossing line sensors:** A section with a dropdown menu showing "# 1", a green "Add aggregate sensor" button, and a red "Delete aggregate sensor" button.
- Crossing line sensors:** A section with a dropdown menu, a green "Add sensor" button, and a red "Remove sensor" button.
- ID sensor:** A text input field containing the value "3".
- Sensor Name:** A text input field containing the value "S3".
- Crossing Time (s):** A text input field containing the value "5".
- Crossing line pre confidence:** A slider control with a value of 0.5.
- Crossing line post confidence:** A slider control with a value of 0.1.
- Crossing line pre-latency:** A text input field containing the value "0".
- Crossing line post latency:** A text input field containing the value "0".

Fig. 45: Configuration of AI-INTRUSION - Multiple crossing line sensors

The configuration section provides the following functions:

**Add aggregate sensor:** Click this button to draw the area of interest directly on the live image on the left. The area of interest is a polygon with no limits to the number of sides. The aggregate sensor can contain multiple crossing lines.

**Remove aggregate sensor:** Click this button to remove the selected aggregate sensor from the configuration.

**ID sensor:** define a numeric ID for the aggregate sensor.

**Sensor name:** this name uniquely identifies the aggregate sensor, it is used to generate events to be sent for example to AI-Dash.

**Crossing time (s):** maximum crossing time in seconds between two successive crossing lines.

It is required to add crossing line sensors within the aggregate sensor (See [Crossing the line, p. 55](#)).

## AI-LOITERING

AI-LOITERING is a video analytic app that is able to detect loitering in indoor and outdoor environments; thus, the environmental conditions will affect the performance of the application, FTP servers and third party servers.

The accuracy to be expected is under ideal environmental and installation conditions

- Recall: 95%

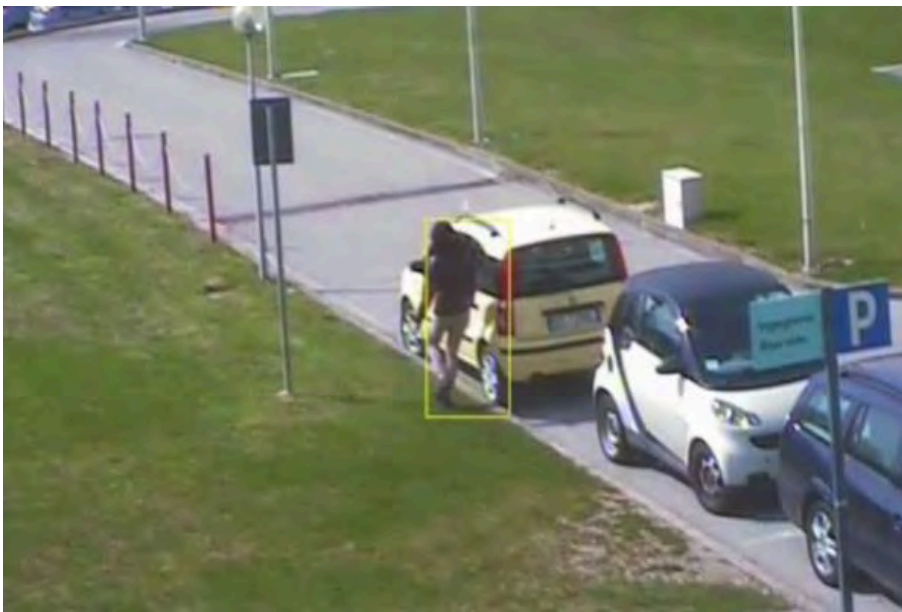


Fig. 46: AI-LOITERING: configuration

### Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.

- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- There must be no fog, clouds or other moving objects whose appearance is similar to the target in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The target must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the target is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The target must stay in the interested area for a time of at least 5 seconds.
- The target must have a minimum area of 100 pixels.
- The target must move at a maximum speed of half their width on the image per frame. For example, a target that is 40 pixels wide at 10 frames per second must move at a speed of no more than 20 pixels per frame, that is 200 pixel per second.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- In case of thermal cameras, the image must be not coloured but in grayscale (white for “hot” pixels, black for “cold” pixels). The camera, thermal or monocular, must be always configured in order to avoid continuous changes of brightness.

### **Installation constraints**

A camera that can be used to detect loitering with AI-LOITERING must comply with the following installation restrictions (in addition to the respect of the environmental conditions):

- It must be installed in such a way that the framed targets (people, vehicles, animals) have a minimum area of 100 pixels.

- If necessary, it must be installed with external illuminators that make it possible to distinguish the targets in all natural or artificial lighting conditions.

## Configuration of AI-LOITERING sensors

Loitering sensors ▾

Sensor color

Loitering sensors ⓘ ▾

# 1 ▾

+ Add sensor

✖ Remove sensor

Redraw the sensor ✎ ⓘ

ID sensor ⓘ

2 ▾

Sensor Name ⓘ

S2

Confidence: ⓘ

0.75

Inhibition (s): ⓘ

30 ▾

Latency alarm (s): ⓘ

10 ▾

**Fig. 47: Configuration of AI-LOITERING sensors**

The configuration section provides the following functions:

**Add Sensor:** Click this button to draw the area of interest directly on the live image on the left. The area of interest it's a polygon with no limits to the number of sides.

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Redraw the sensor:** Click to delete the current sensor and draw a new one.

**ID sensor:** define an ID number for the sensor.

**Sensor name:** this name uniquely identifies the sensor.

**Confidence:** A small value will make the algorithm very sensitive, instead with a value too large the algorithm could not generate the alarms.

**Inhibition (s):** Inhibition time in seconds of the sensor after an alarm has been generated. If an alarm is generated by the same sensor before the inhibition time is passed, it will be ignored by the system.

**Latency alarm (s):** Minimum intrusion time (seconds of permanence in the area of interest) before an alarm is generated. Time in seconds. Subjects who stay in the area of interest for less time than the set latency, won't generate any alarm.

## AI-LOST

AI-LOST is a video analytic app that is able to detect abandoned or removed objects in indoor and outdoor environments; thus, the environmental conditions will affect the performance of the application.

The accuracy to be expected is under ideal environmental and installation conditions

- Recall: 90%

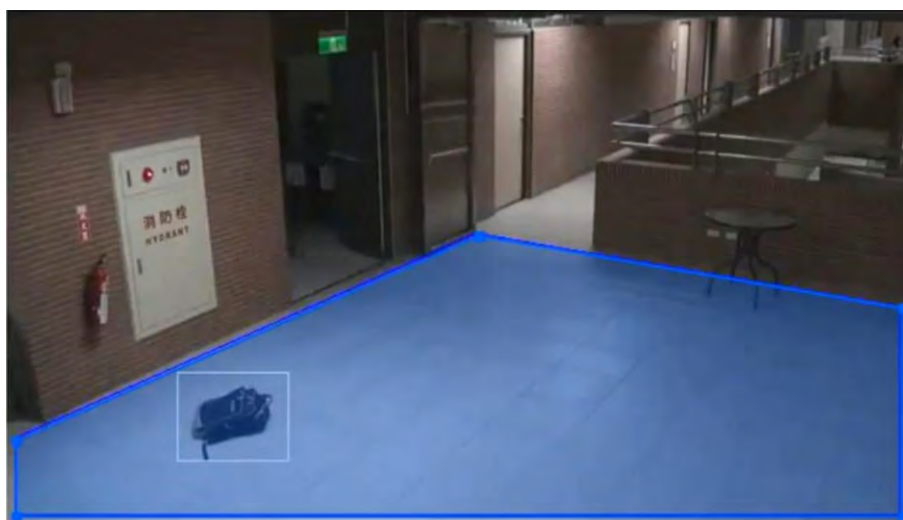


Fig. 48: AI-LOST: configuration

### Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- There must be no fog, clouds or other moving objects whose appearance is similar to the target in the areas of interest.

- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The target must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the target is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The target must stay in the interested area for a time of at least 5 seconds.
- The target must have a minimum area of 100 pixels.
- The target must move at a maximum speed of half their width on the image per frame. For example, a target that is 40 pixels wide at 10 frames per second must move at a speed of no more than 20 pixels per frame, that is 200 pixel per second.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- In case of thermal cameras, the image must be not coloured but in grayscale (white for "hot" pixels, black for "cold" pixels). The camera, thermal or monocular, must be always configured in order to avoid continuous changes of brightness.



AI-LOST - target size

### Installation constraints

A camera that can be used to detect loitering with AI-LOITERING must comply with the following installation restrictions (in addition to the respect of the environmental conditions):

- It must be installed in such a way that the framed targets (people, vehicles, animals) have a minimum area of 100 pixels.
- If necessary, it must be installed with external illuminators that make it possible to distinguish the targets in all natural or artificial lighting conditions.

## Configuration of AI-LOST sensors

Lost sensors ▾

**Sensor color**

☒ Enable detection of abandoned or removed objects

Lost sensors ⓘ ▾

# 1 ▾

+ Add sensor

✖ Remove sensor

Redraw the sensor ✏ ⓘ

ID sensor ⓘ

1 ▴ ▾

Sensor Name ⓘ

S1

Confidence: ⓘ

0.75

Inhibition (s): ⓘ

30 ▴ ▾

Latency alarm (s): ⓘ

30 ▴ ▾

**Fig. 49: Configuration of AI-LOST sensors**

The configuration section provides the following functions:

**Add Sensor:** Click this button to draw the area of interest directly on the live image on the left. The area of interest it's a polygon with no limits to the number of sides.

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Redraw the sensor:** Click to delete the current sensor and draw a new one.

**ID sensor:** define an ID number for the sensor.

**Sensor name:** this name uniquely identifies the sensor.

**Confidence:** A small value will make the algorithm very sensitive, instead with a value too large the algorithm could not generate the alarms.

**Inhibition (s):** Inhibition time in seconds of the sensor after an alarm has been generated. If an alarm is generated by the same sensor before the inhibition time is passed, it will be ignored by the system.

**Latency alarm (s):** Minimum intrusion time (seconds of permanence in the area of interest) before an alarm is generate. Time in seconds. Subjects who stay in the area of interest for less time than the set latency, won't generate any alarm.

## Configuration of AI-LOST Entrance areas

In order to reduce the number of false positives and to consider only the objects which enters from specific parts of the image, it is possible to draw an unlimited number of entrance areas.

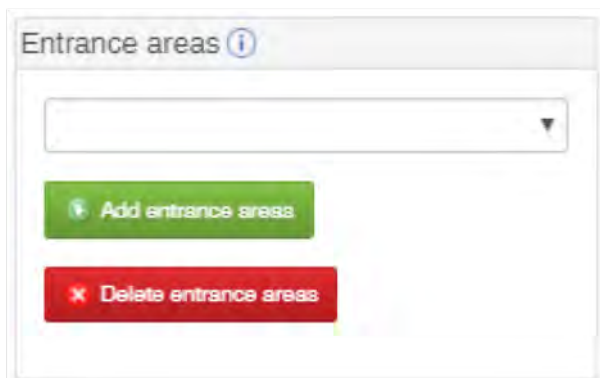


Fig. 50: Configuration of AI-LOST entrance areas

The configuration section provides the following functions:

**Add entrance area:** Click this button to draw an entrance area of directly on the live image on the left. The entrance area is a polygon with no limits to the number of sides.

**Delete entrance area:** Click this button to remove the selected entrance area from the configuration.



# AI-CROWD-DEEP

AI-CROWD-DEEP is the video analysis plug in based on deep neural networks, that allows to analyze the people in an area, even in very crowded situations. The solution, not being based on the analysis of the movement, does not suffer from disturbances due to the movement of the camera that takes the scene.

## AI-CROWD-DEEP

AI-CROWD-DEEP is the video analysis plug in based on deep neural networks, that allows to analyze the people in an area, even in very crowded situations. The solution, not being based on the analysis of the movement, does not suffer from disturbances due to the movement of the camera that takes the scene.

AI-CROWD-DEEP allows to estimate the number of people in an area, generate an alarm when a threshold is exceeded, as well as generate an alarm if social distancing between people is not respected.

The app can be used in indoor environments, for example in retail or business intelligence, but also in outdoor environments, for example in smart cities or in transportation.

The accuracy to be expected is 90% under ideal environmental and installation conditions.

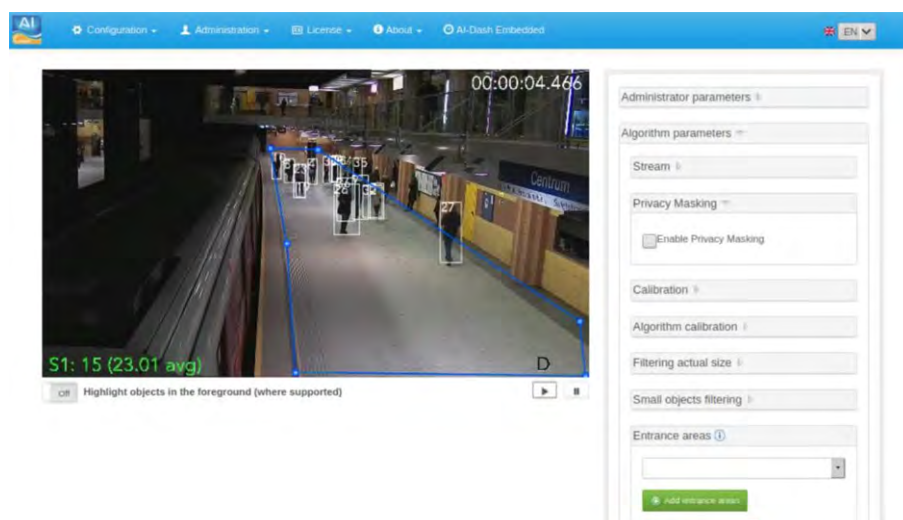


Fig. 51: AI-CROWD-DEEP: configuration

## Environment conditions

AI-CROWD-DEEP is a video analytic plug in optimized to estimate the number of persons inside one or more areas of interest in typical retail scenarios, as well as smart cities and transportation or security and safety. The correct positioning of the camera and the environmental conditions represent two factors that affects the performance of the application.

- The image must not present flickering, severe noise or artifacts.
- The image must have a minimum resolution of 512 x 288 px.

- A person must have a minimum height of 30 pixels.
- A persons height must be at least 1/10 of the image height.
- The image must be in landscape orientation with 16:9 aspect ratio.
- The camera is fixed. Rotating security cameras are not supported for social distance analysis and for analytics that include multiple sensors drawn on the image. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or occlusion that do not allow to count the individuals.
- Absence of sensors configured exactly under the camera (bird view): the plug in is not able to detect people from an overhead view.
- The body of a person must be visible for at least 3/4 of its height.
- The camera must be installed in a way that it provides a frontal/side view of the persons.
- The use of cameras pointed towards the ground, giving a view from the top is not supported since the head and the shoulders may be not sufficient to recognize a person.
- There must be no fog, clouds, other objects or strong shadows whose appearance is similar to the people in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Persons must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image.
- If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- Persons must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The scene must be a predominantly non-reflective surface.

## Configuration

AI-CROWD requires the following configurations:

## Basic configuration

1. Draw the crowd estimation sensor
  - avoiding the region under the camera. The person should be not framed overhead, a frontal view is required.
  - The sensor must be drawn on areas where people are expected to walk, i.e. in such a way that the feet of people are in the sensor. The sensor must not include portions of the sky.
2. Configure at least one event manager to collect the events
3. If needed configure the overcrowding threshold and enable overcrowd detection.

## For social distance analysis

1. Draw an additional “distance analysis sensor” following the same rules as for the crowd estimation sensor described above.
2. Configure at least one event manager to collect the events
3. 3D calibration is an additional mandatory step. Many tips for that are available on our web site.
  - Draw two pair of parallel lines where one pair is perpendicular to the other
  - Specify the height and the focal length of the camera
  - Fine tune the calibration before turning off the visualization of calibration data.

## Additional configurations

- If you need to configure the period between the sending of two consecutive crowd events; the default works just fine in the most cases
- Optionally you can fine tune latency, confidence and inhibition for the overoccupancy analytic
- Optionally you can configure the minimum and maximum pixel size of an object of interest
- If real size filtering (in meters) is required: calibrate the camera by correctly specifying height, horizontal angle of view and vertical angle of view, then complete the calibration of the algorithm by correctly specifying the inclination angle of the camera and the training samples
- If needed, schedule the applications in specific time intervals

# AI-CROWD-PLUS

AI-CROWD-PLUS is a bundle including two different products, simultaneously installed on board of your camera.

- **AI-CROWD:** Crowd estimation
- **AI-OVERCROWD:** Overcrowding detection for queue management

## Camera positions

- The camera should be mounted with a reduced focal length and an horizontal field of view in the range between 60° and 120°, chosen with respect to the gate.
- The camera must be mounted in a overhead position considering an 90° angle measured to ground.
- The camera should be mounted at a height between 3 and 5 meters
- The precision of the muggins is maximum when people are recorded from the top without distorsion on the sides

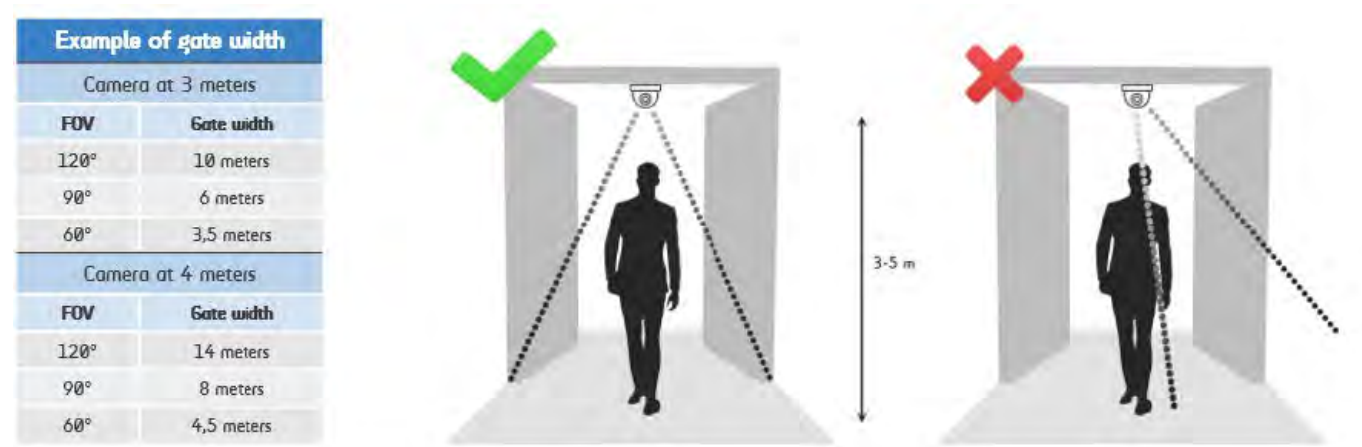


Fig. 52: camera position

## Recomended distances

Camera height (m)	Maximum gate width (m)
3	6
3,5	7,5

Camera height (m)	Maximum gate width (m)
4	9
4,5	10
5	12

## AI-CROWD

AI-CROWD is the plug in that can be used in crowded areas where persons can stop or move slowly, even determining queuing situations. It allows to estimate the number of persons inside one or more areas of interest. It generates events that can be managed by AI-Dash, FTP servers and third party servers.

The accuracy to be expected is 90% under ideal environmental and installation conditions.

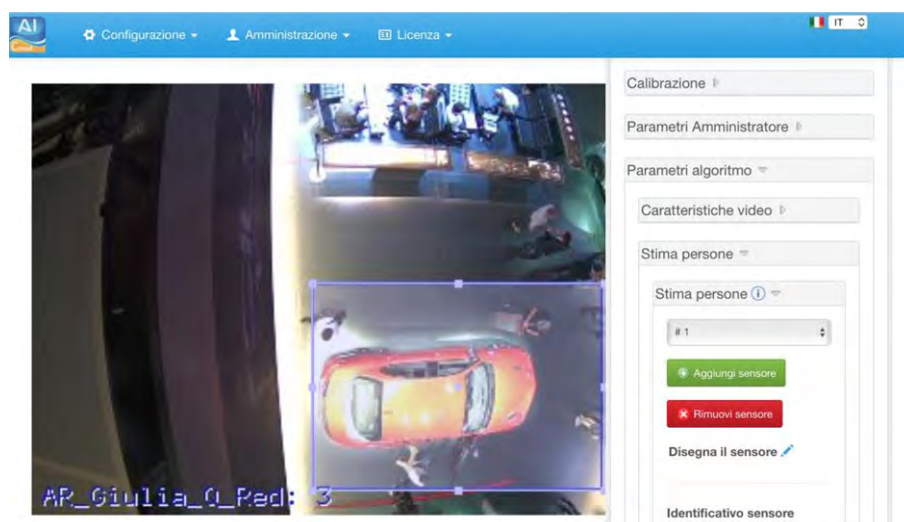


Fig. 53: AI-CROWD: configuration

## Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.

- Absence of stationary or slow-moving people for long periods in the counting area (e.g. Sales people that encourage customers to enter).
- There must be no other moving objects whose appearance is similar to the people in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The people must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The people must have a minimum area of 200 pixels (e.g. 10x20, 5x40, ...).
- The floor must be a predominantly non-reflective surface.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

## Drawing the sensor for AI-CROWD

When drawing the crowd estimation sensor consider the following guideline:

- Configure the minimum area occupied by a person by drawing a rectangle around the shoulders.



**Fig. 54: Drawing sensor for AI-CROWD**

## Configuration of AI-CROWD

Crowd ▾

Crowd ⓘ ▾


# 1 ▾

+

 Add sensor

×

 Remove sensor

Redraw the sensor 

ID sensor

11 ▾


Sensor Name

S3

Events period (s): ⓘ

60 ▾

Relative person area:

0,099113 ▾ 

☒ Enable crowd estimation ⓘ

Fig. 55: Configuration of AI-CROWD

The configuration section provides the following functions:

**Add Sensor:** Click this button to draw a virtual sensor with the mouse method “click and drag”. The sensor can be moved and changed in its size, by dragging the nodes. You can direct the sensor (the counting direction is given by the arrow), for example rotating the sensor until the arrow points to the desired direction, or specify if the sensor is monodirectional rather than bidirectional .

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Redraw the sensor:** Click to delete the current sensor and draw a new one.

**ID sensor:** define an ID number for the sensor.

**Sensor name:** this name uniquely identifies the main counting sensor (green arrow); is used to generate counting events, sent, for example, to AI-Dash.

**Event period(s):** interval in seconds between two consecutive events that need to be sent to an external server.

**Enable crowd estimation:**check to activate AI-CROWD.

## AI-OVERCROWD

AI-OVERCROWD is a video analytic app that can be used to detect overcrowding inside one or more areas of interest in typical retail scenarios; of course, the position of the camera and the environmental conditions will affect the performance of the application.

The accuracy to be expected is 90% under ideal environmental and installation conditions.



Fig. 56: AI-OVERCROWD

### Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:



- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- Absence of stationary or slow-moving people for long periods in the counting area (e.g. Sales people that encourage customers to enter).
- There must be no other moving objects whose appearance is similar to the people in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The people must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The people must have a minimum area of 200 pixels (e.g. 10x20, 5x40, ...).
- The floor must be a predominantly non-reflective surface.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

## Drawing the sensor for AI-OVERCROWD

When drawing the crowd estimation sensor consider the following guideline:

- Configure the minimum area occupied by a person by drawing a rectangle around the shoulders.



Fig. 57: Drawing sensor for AI-CROWD

## Configuration of AI-OVERCROWD

Fig. 58: Configuration of AI-OVERCROWD

The configuration section provides the following functions:

**Confidence:** A small value ( $< 0,5$ ) will make the algorithm very sensitive, instead with a value too large ( $> 0,8$ ) the algorithm could not generate the alarms. It's suggested to use a value between 0,5 and 0,75.

**Inhibition(s):** inhibition time of the sensor in seconds after an alarm has been generated. If an alarm is generated by the same sensor before the inhibition time is passed, will be ignored by the system.

**Latency(s):** Minimum crowding time in seconds (number of people over the configured threshold) before an alarm is generate.

**Overcrowd threshold:** If the number of the persons in the region of interest exceeds the selected threshold, the application creates a new overcrowd event.

# AI-FACEDETECT-DEEP

AI-FACEDETECT-DEEP is the video analytics app able to detect the faces of the persons inside the scene. It is also able to distinguish faces with mask from faces without mask. It implies that the plug in can be used for both statistical (in order to know the number of persons inside an area) and security purposes (by opening a door only if the face of the person is well visible).

## AI-FACEDETECT-DEEP - camera positions

- The camera must be frontal with respect to people faces, at an height about 1,8 m
- The camera must be installed at a distance from the faces so that the face area is at least 600 pixels.
- It must be installed in a place sufficiently illuminated, so that the facial landmarks are perfectly visible.
- The camera must be installed on a pole or, more in general, in a place completely steady; otherwise, the camera vibrations can have a negative impact on the performance.
- The camera must be positioned in a place which attracts the glance of the people, so that the faces are framed in frontal position.



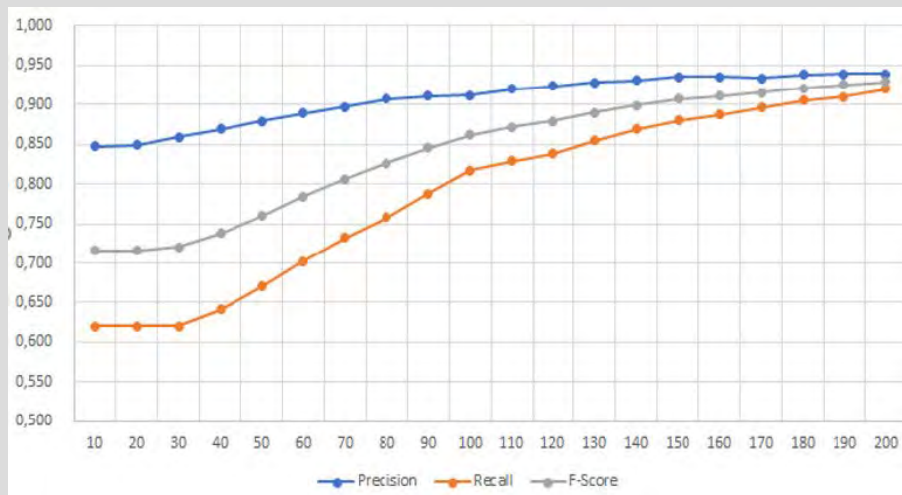
Fig. 59: AI-FACEDETECT-DEEP Camera positions

## AI-FACEDETECT-DEEP

AI-FACEDETECT-DEEP is the plug in for detecting all the faces in the image, verifying if the face is masked or not. The user can configure whether is interested to face not masked, masked or both. The plug in generates events that can be managed by all the notification channels.

Whether the environmental conditions and the installation constraints are respected, the expected performance of AI-FACEDETECT-DEEP is variable depending on the face size in the image.

See the following diagram (on the x-axis it is reported the height of the face image in pixels):



The recall is expected to grow over 90% whether a single face is present very close to the camera (e.g. face verification for access control).

## Environment conditions

AI-FACEDETECT-DEEP is a video analytic plugin optimized to detect the faces in indoor and outdoor scenarios; of course, the position of the camera and the environmental conditions will affect the performance of the application.

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating security cameras are not supported; PTZ cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or occlusion that do not allow to count the individuals.
- There must be no other objects whose appearance is similar to faces in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image.

- Persons must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The face must have a minimum area of 600 pixels (e.g. 20x30, 15x40, ...).
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

## Configuration

AI-FACEDETECT-DEEP requires the following configurations:

### Basic configuration

1. Draw the sensor for face analysis.

#### Note

For improving the performance of the face detector, draw a sensor with an aspect ratio (width:height) equal to 4:3.

The smaller the sensor, the higher the resolution of the detected face.

2. Configure the minimum and maximum pixel size of the faces to detect.
3. Configure the “Deep” detection algorithm.
4. Configure the minimum confidence.
5. Configure the type of event and face you are interested in.
6. Configure at least one event manager to collect the events.
7. If needed, schedule the applications in specific time intervals.



## AI-RETAIL3

AI-RETAIL3 is a bundle including three different products, simultaneously installed on board of your camera.

- **AI-PEOPLE:** People counting through gates
- **AI-CROWD:** Crowd estimation
- **AI-OVERCROWD:** Overcrowding detection for queue management

## Camera positions

- The camera should be mounted with a reduced focal length and an horizontal field of view in the range between 60° and 120°, chosen with respect to the gate.
- The camera must be mounted in a overhead position considering an 90° angle measured to ground.
- The camera should be mounted at a height between 3 and 5 meters
- The precision of the muggins is maximum when people are recorded from the top without distorsion on the sides

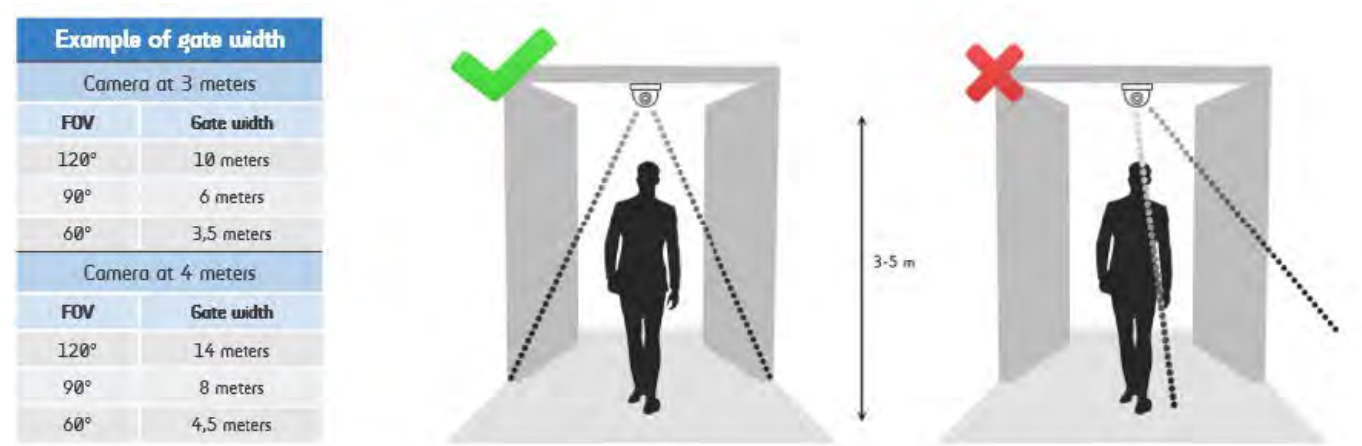


Fig. 60: camera position

## Recommended distances

Camera height (m)	Maximum gate width (m)
3	6
3,5	7,5
4	9
4,5	10
5	12

## AI-PEOPLE

AI-PEOPLE is a video analytic app optimized to count people crossing a gate in typical retail scenarios. It generates events that can be managed by all the notification channels.

The accuracy to be expected is under ideal environmental and installation conditions

Indoor:

■ Recall: 85%

■ Precision: 95%

Outdoor:

■ Recall: 85%

■ Precision: 85%



## Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- Absence of stationary or slow-moving people for long periods in the counting area (e.g. Sales people that encourage customers to enter).
- There must be no other moving objects whose appearance is similar to the people in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The people must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The people must have a minimum area of 600 pixels (e.g. 20x30, 15x40, ...).
- The floor must be a predominantly non-reflective surface.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

## Drawing the people counting sensor

When drawing the counting sensor the following 3 guidelines must be considered:

- **Correct width:** It must occupy the entire area of the gate horizontally
- **Correct height:** The vertical half of the sensor should include head and shoulders
- **Correct position:** the sensor must be parallel to the gate, so that people crossing it from top to bottom or viceversa, and must not include moving objects in its area (doors, sliding or not, screens etc.)

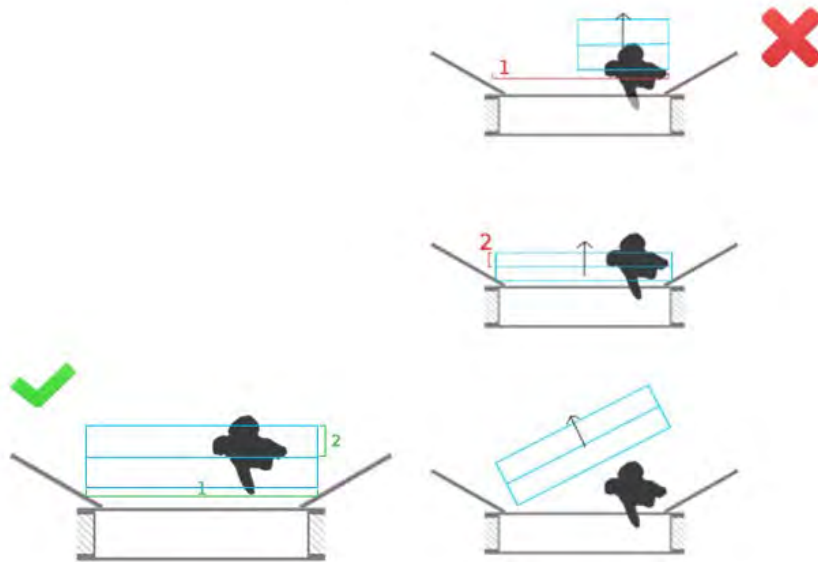


Fig. 61: Examples of correct and wrong sensor drawing

## Configuring people counting

Counting

☐ Reset counters

Sensor color

Counting

# 1

Add sensor

Remove sensor

Redraw the sensor

Real width (m)

2

☒ Bidirectional

ID sensor

4

Sensor ID (reverse direction)

5

Sensor Name

S1

Sensor Name (reverse direction)

S2

Sensor's activation threshold:

0.2

Aggregate counting

☐ Enable aggregate counting

Fig. 62: Configuration of AI-PEOPLE

The configuration section provides the following functions:

**Reset counters:** when checked the counters associated to the counting sensors will be reset when the application is restarted.

**Add Sensor:** Click this button to draw a virtual sensor with the mouse method “click and drag”. The sensor can be moved and changed in its size, by dragging the nodes. You can direct the sensor (the counting direction is given by the arrow), for example rotating the sensor until the arrow points to the desired direction, or specify if the sensor is monodirectional rather than bidirectional .

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Real width (m):** real width of the sensor in meters. The empirical rule to specify this value, used when the real dimension is not measurable, suggests to compute the maximum number of people who can cross the gate at the same time multiplied for 0.75. However, it approximates the real condition and may not be precise enough.

**Bidirectional:** specify if the sensor is mono or bidirectional.

**Sensor name:** this name uniquely identifies the main counting sensor (green arrow); is used to generate counting events, sent, for example, to AI-Dash.

**Sensor name (reverse direction):** this name uniquely identifies the counting sensor in the reverse direction (red arrow); is used to generate counting events, sent ,for example, to AI-Dash;

**Sensor activation threshold:** A value too small ( $< 0,1$ ) would make the sensor very sensitive and the sensor could give false positive in this case. A value too big ( $> 0,6$ ) would make the sensor not very sensitive and in this case, the sensor could miss some person crossing.

After checking **Enable aggregate counting**, it's possible to send the events if the difference between entrances and exits is over a certain threshold (see [AI-PEOPLE: Aggregate counting, p. 84](#)).

## AI-PEOPLE: Aggregate counting

### Configuring aggregate counting

Before configuring aggregate counting make sure the basic [AI-PEOPLE, p. 80](#) is ready configured.

Aggregate counting ⓘ ▼

☒ Enable aggregate counting ⓘ

**ID sensor** ⓘ

**Sensor Name** ⓘ

**Threshold** ⓘ

**Sensors to aggregate** ⓘ ▼
 

**Aggregate sensor** ⓘ

**Sensor type** ⓘ

Fig. 63: Aggregate counting

After checking **Enable aggregate counting**, it's possible to send the events if the difference between entrances and exits is over a certain threshold

The following parameters are to be configured to use this functionality:

**ID sensor:** univocal ID automatically generated;

**Sensor name:** this name uniquely identifies the aggregate sensor; is used to generate counting events, sent, for example, to AI-Dash;

**Threshold:** The event will be generated when the difference between entries and exits will be above this value (threshold).

In section **Sensors to aggregate** you can add the desired number of sensors which will form the aggregate sensor:

**Aggregate sensor:** drop down menu that permit to select the name of the sensor just created in the section “Counting” (BE AWARE: if you created a Bidirectional sensor, in the section “Counting”, the generated sensors will be two with the respective name and identifier);

**Sensor type:** specifies if the selected sensor in the previous drop down menu counts entries (IN) or exits (OUT).

## AI-CROWD

AI-CROWD is the plug in that can be used in crowded areas where persons can stop or move slowly, even determining queuing situations. It allows to estimate the number of persons inside one or more areas of interest. It generates events that can be managed by AI-Dash, FTP servers and third party servers.

The accuracy to be expected is 90% under ideal environmental and installation conditions.

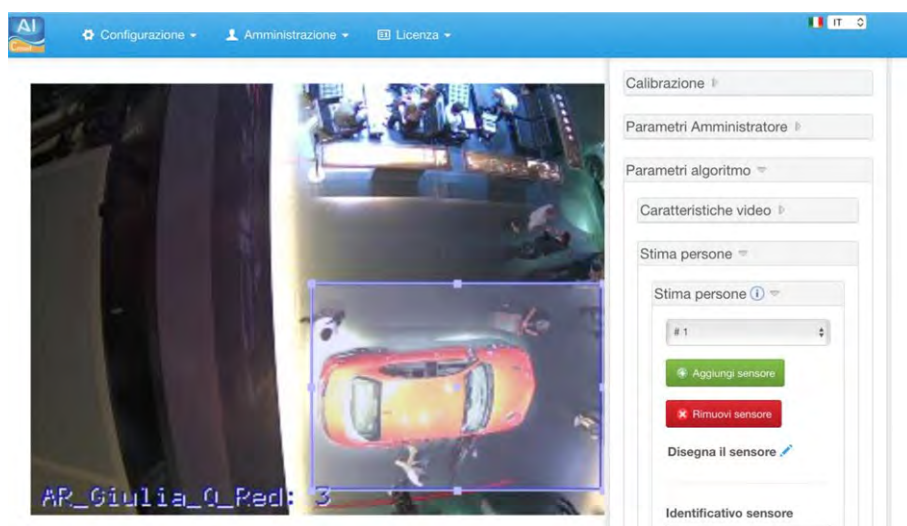


Fig. 64: AI-CROWD: configuration

## Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.

- Absence of stationary or slow-moving people for long periods in the counting area (e.g. Sales people that encourage customers to enter).
- There must be no other moving objects whose appearance is similar to the people in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The people must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The people must have a minimum area of 200 pixels (e.g. 10x20, 5x40, ...).
- The floor must be a predominantly non-reflective surface.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

## Drawing the sensor for AI-CROWD

When drawing the crowd estimation sensor consider the following guideline:

- Configure the minimum area occupied by a person by drawing a rectangle around the shoulders.



Fig. 65: Drawing sensor for AI-CROWD

Configuration of AI-CROWD

Crowd ▾

Crowd ⓘ ▾

# 1 ▾

+

Add sensor

×

Remove sensor

Redraw the sensor

ID sensor

11 ▴ ▾

Sensor Name

S3

Events period (s): ⓘ

60 ▴ ▾

Relative person area:

0,099113 ▴ ▾

☒ Enable crowd estimation ⓘ

Fig. 66: Configuration of AI-CROWD



The configuration section provides the following functions:

**Add Sensor:** Click this button to draw a virtual sensor with the mouse method “click and drag”. The sensor can be moved and changed in its size, by dragging the nodes. You can direct the sensor (the counting direction is given by the arrow), for example rotating the sensor until the arrow points to the desired direction, or specify if the sensor is monodirectional rather than bidirectional .

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Redraw the sensor:** Click to delete the current sensor and draw a new one.

**ID sensor:** define an ID number for the sensor.

**Sensor name:** this name uniquely identifies the main counting sensor (green arrow); is used to generate counting events, sent, for example, to AI-Dash.

**Event period(s):** interval in seconds between two consecutive events that need to be sent to an external server.

**Enable crowd estimation:** check to activate AI-CROWD.

## AI-OVERCROWD

AI-OVERCROWD is a video analytic app that can be used to detect overcrowding inside one or more areas of interest in typical retail scenarios; of course, the position of the camera and the environmental conditions will affect the performance of the application.

The accuracy to be expected is 90% under ideal environmental and installation conditions.



Fig. 67: AI-OVERCROWD

### Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.

- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- Absence of stationary or slow-moving people for long periods in the counting area (e.g. Sales people that encourage customers to enter).
- There must be no other moving objects whose appearance is similar to the people in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The people must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The people must have a minimum area of 200 pixels (e.g. 10x20, 5x40, ...).
- The floor must be a predominantly non-reflective surface.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

## Drawing the sensor for AI-OVERCROWD

When drawing the crowd estimation sensor consider the following guideline:

- Configure the minimum area occupied by a person by drawing a rectangle around the shoulders.

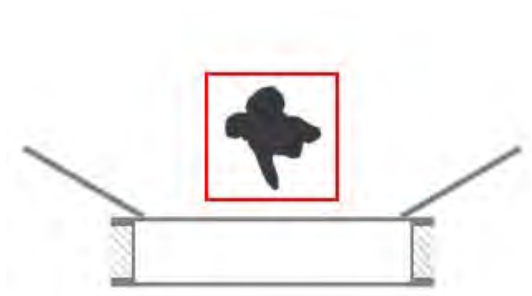


Fig. 68: Drawing sensor for AI-CROWD

## Configuration of AI-OVERCROWD

Fig. 69: Configuration of AI-OVERCROWD

The configuration section provides the following functions:

**Confidence:** A small value ( $< 0,5$ ) will make the algorithm very sensitive, instead with a value too large ( $> 0,8$ ) the algorithm could not generate the alarms. It's suggested to use a value between 0,5 and 0,75.

**Inhibition(s):** inhibition time of the sensor in seconds after an alarm has been generated. If an alarm is generated by the same sensor before the inhibition time is passed, will be ignored by the system.

**Latency(s):** Minimum crowding time in seconds (number of people over the configured threshold) before an alarm is generate.

**Overcrowd threshold:** If the number of the persons in the region of interest exceeds the selected threshold, the application creates a new overcrowd event.



## AI-TRAFFIC

AI-TRAFFIC is a bundle including three different products, simultaneously installed on board of your camera.

- **AI-ROAD 3D:** gathering of traffic statistics
- **AI-INCIDENT:** road monitoring for security purposes

## Configuration of AI-TRAFFIC analysis

Traffic analysis ⓘ

# 1 ▼

Add sensor

Remove sensor

Redraw the sensor ✎

ID sensor ⓘ

6

Sensor Name ⓘ

S6

☒ Enable vehicle counting and classification ⓘ

☐ Enable high speed limit control ⓘ

☐ Enable traffic density monitoring ⓘ

☐ Enable congestion control ⓘ

☐ Enable wrong way control ⓘ

Fig. 70: Configuration of AI-LOST sensors

The configuration section provides the following functions:

**Add Sensor:** Click this button to draw the area of interest directly on the live image on the left. The area of interest it's a polygon with no limits to the number of sides.

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Redraw the sensor:** Click to delete the current sensor and draw a new one.

**ID sensor:** define an ID number for the sensor.

**Sensor name:** this name uniquely identifies the sensor.

**Enable vehicle counting and classification:** It is enabled by default and allows to count and classify vehicles, collecting also information about the average speed and color of each vehicle. Available in AI-ROAD 3D.

**Enable high speed limit control:** Allows to send a notification for each vehicle which overcome the speed limit, specified during the configuration. Available in AI-ROAD 3D.

**Enable traffic density monitoring:** Allows to send a periodical notification, with a period specified during the configuration, along with the information about the traffic density. Available in AI-ROAD 3D.

**Enable congestion control:** Allows to send a notification in case of congestion. Available in AI-INCIDENT.

**Enable wrong way control:** Allows to send a notification for each vehicle which crosses the sensor in the wrong direction. Available in AI-INCIDENT.

## AI-TRAFFIC- stopped vehicle or pedestrian

**Fig. 71: Configuration of AI-TRAFFIC stopped vehicle or pedestrian**

The configuration section provides the following functions:

**Add Sensor:** Click this button to draw the area of interest directly on the live image on the left. The area of interest it's a polygon with no limits to the number of sides.

**Remove sensor:** Click this button to remove the selected sensor from the configuration.

**Redraw the sensor:** Click to delete the current sensor and draw a new one.

**ID sensor:** define an ID number for the sensor.

**Sensor name:** this name uniquely identifies the sensor.

**Enable pedestrians detection:** It is enabled by default and allows to count and classify vehicles, collecting also information about the average speed and color of each vehicle. Available in AI-INCIDENT.

**Enable stopped vehicles detection:** Allows to send a notification if a pedestrian spends more than “Latency” seconds in the sensor. Available in AI-ROAD 3D.

**Enable traffic density monitoring:** Allows to send a periodical notification, with a period specified during the configuration, along with the information about the traffic density. Available in AI-ROAD 3D.

**Latency (s):** Define a latency value in seconds.

## Configuration of AI-TRAFFIC Entrance areas

In order to reduce the number of false positives and to consider only the objects which enters from specific parts of the image, it is possible to draw an unlimited number of entrance areas.

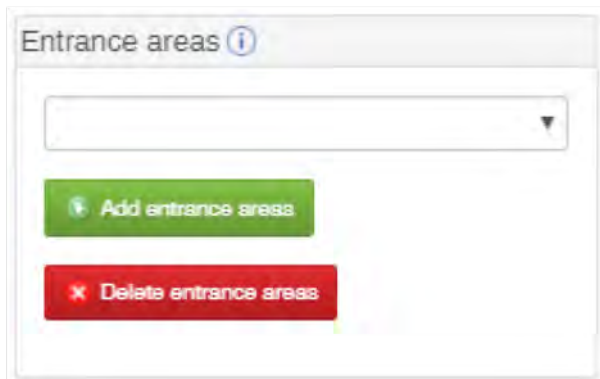


Fig. 72: Configuration of AI-TRAFFIC entrance areas

The configuration section provides the following functions:

**Add entrance area:** Click this button to draw an entrance area of directly on the live image on the left. The entrance area is a polygon with no limits to the number of sides.

**Delete entrance area:** Click this button to remove the selected entrance area from the configuration.

## AI-TRAFFIC - camera positions

- The camera must be mounted in order to assure that the maximum angle between it and the road is 30°.
- The camera should frame the vehicles from behind, so as to avoid the negative effect of the headlights.
- The camera should be varifocal for outdoor environments.
- The camera must be installed on a pole or, more in general, in a place completely steady; otherwise, the camera vibrations can have a negative impact on the performance.
- The camera must be mounted at a minimum height of 5 meters; in any case, it is important to avoid occlusions between vehicles.



- The camera must be mounted with a minimum inclination angle of  $15^\circ$ ; in any case, it is important to avoid occlusions between vehicles.
- The minimum area in pixels of a vehicle must be  $50 \times 50$ ; the zoom must be configured according to this constrain.

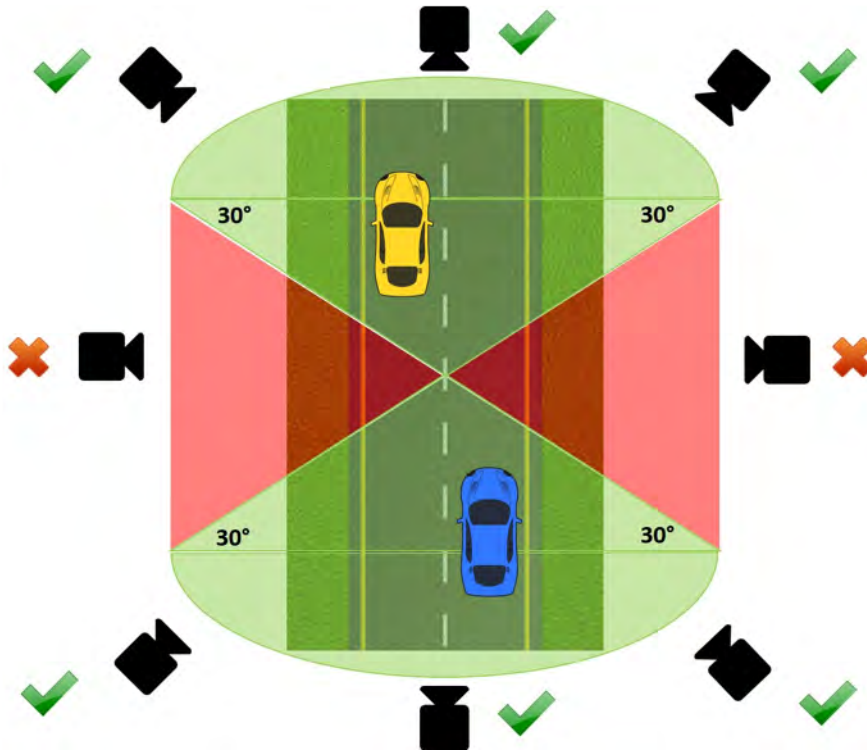


Fig. 73: AI-TRAFFIC Camera positions 1



Fig. 74: AI-TRAFFIC Camera positions 2

## AI-ROAD 3D

AI-ROAD 3D is a video analytic app optimized to monitor the road traffic in real-time; thus, the environmental conditions will affect the performance of the application.

The accuracy to be expected is under ideal environmental and installation conditions

Vehicle Detection:

- Recall: 90%
- Precision: 95%

Vehicle Classification:

- Motorcycle Accuracy: 75%
- Car Accuracy: 95%
- Truck Accuracy: 85%



Fig. 75: AI-ROAD 3D: configuration

## Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- There must be no fog, clouds or other moving objects whose appearance is similar to the target in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding).
- Absence of vehicles with lights projected towards the camera.

- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the target in all natural or artificial lighting conditions.
- The target must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the target is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- Absence of vehicles with lights projected in areas of interest.
- The target must stay in the interested area for a time of at least 1 second.
- The target must have a minimum area of 2500 pixels (e.g. 50x50).
- The target must move at a maximum speed of half their width on the image per frame. For example, a target that is 40 pixels wide at 10 frames per second must move at a speed of no more than 20 pixels per frame, that is 200 pixel per second.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- In case of thermal cameras, the image must be not coloured but in grayscale (white for “hot” pixels, black for “cold” pixels). The camera, thermal or monocular, must be always configured in order to avoid continuous changes of brightness.

## Drawing the people counting sensor

When drawing the counting sensor the following guidelines must be considered:

- Sensors can be configured only on straight roads
- Sensors can be configured only on roads or lanes oriented in the same direction of the reference lines, not in different ones

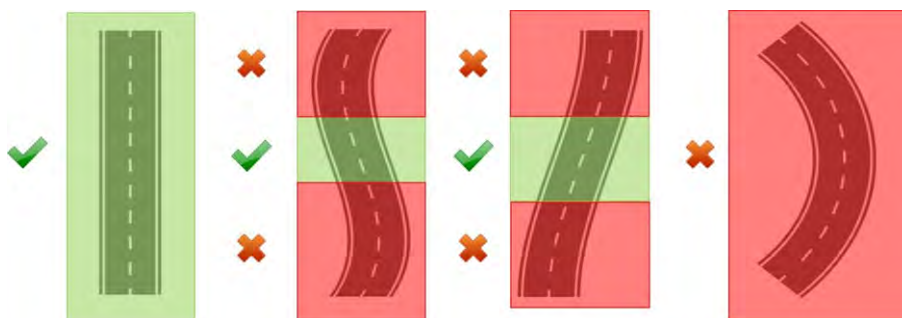


Fig. 76: AI-ROAD 3D Sensor drawing

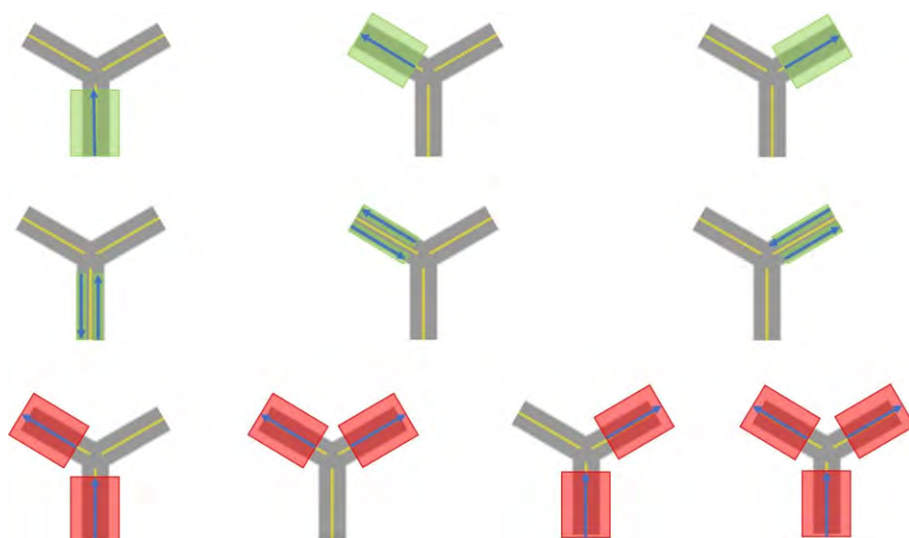


Fig. 77: AI-ROAD 3D Lane direction

## AI-ROAD 3D - 3D Calibration

The 3D calibration is a procedure mandatory to enable the functionalities available in AI-Traffic. Since it is a crucial step of the configuration, it has been designed to be very easy for the user. All the parameters regarding the calibration are in the tabs “Calibration” and “3D calibration”.

**IMPORTANT:** set the real height of the camera (with respect to the road) in meters; an error on the configuration of this field negatively affects the results of the calibration procedure.

Then, the procedure includes the following three steps:

**Step 1:** Drawing of parallel lines along the road

**Step 2:** Drawing of parallel lines vertical (**Case A**) or crossroad (**Case B**)

**Step 3:** Configuration of camera parameters (**Case A**) or drawing of a reference line (**Case B**)

it may be comfortable to pause the video stream to simplify the configuration.

Calibration ▾

Camera height (m): ⓘ

9

3D calibration ▾

☒ Show/edit calibration data

Calibration type

Lines only on the road ▾

Draw first line crossroad ✎

Draw second line crossroad ✎

Draw first line along the road ✎

Draw second line along the road ✎

Real size reference

Camera parameters ▾

Focal length (mm)

4

Sensor width (mm) ⓘ

7,18

Fig. 78: 3D Calibration for AI-ROAD 3D

## AI-ROAD 3D: 3D calibration – Step 1

### Draw the parallel lines along the road (blue)

Draw first line along the road ✎

Draw second line along the road ✎

Fig. 79: Draw lines along the road

As shown in the image below, you can use the boundary lines of the carriageway or any other line parallel to the motion direction.

Be careful that the lines are drawn with accuracy, since an error in this step may negatively affect the results of the calibration.



Fig. 80: Draw parallell lines to define the road

## AI-ROAD 3D: 3D calibration – Step 2 - Case A

### Draw the parallel vertical lines (green)

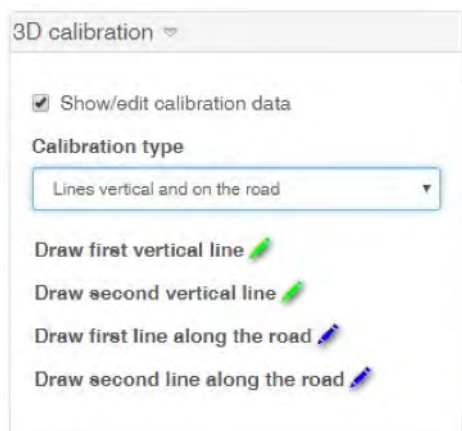


Fig. 81: Draw vertical lines for calibration

As shown in the image below, if there are vertical parallel lines (e.g. street lamps, buildings) you can use them to perform the step 2 of the calibration.

Be careful that the lines are drawn with accuracy, since an error in this step may negatively affect the results of the calibration.



Fig. 82: Draw vertical lines to define the road

## AI-ROAD 3D: 3D calibration – Step 2 - Case B

### Draw the parallel lines crossroad (red)

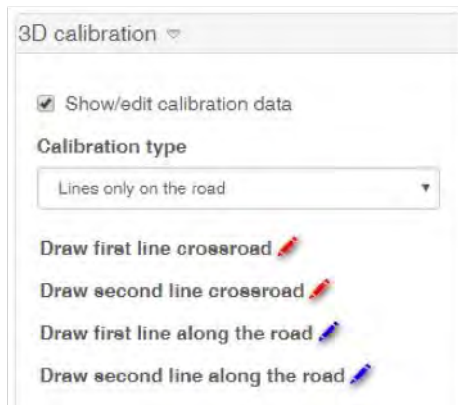


Fig. 83: Draw crossroad lines for calibration

In some cases are no vertical parallel lines available in the scene; thus, the plugin must provide an alternative way to complete the calibration. As shown in the image on the right, in this case you can use parallel lines crossroad to perform the step 2 of the calibration. The easier way is to pause the video stream and to use the back of two vehicles as a reference; of course, if crossroad lines are available, it is better to use them.

Be careful that the lines are drawn with accuracy, since an error in this step may negatively affect the results of the calibration.





Fig. 84: Draw crossroad lines to define the road

## AI-ROAD 3D: 3D calibration – Step 3 - Case A

This way to perform the calibration is the most accurate but it requires some attempts to find the right value of the focal length. Therefore [AI-ROAD 3D: 3D calibration – Step 3 - Case B, p. 105](#) might be more comfortable.

### Provide the camera lens parameters

**Real size reference**  

Camera parameters ▼

**Focal length (mm)**  

4

**Sensor width (mm) ⓘ**  

7,18

Fig. 85: Provide the camera lens parameters

**Focal length:** this value normally is provided on the cameras data sheet as a range between the minimum and the maximum focal length (e.g. 5.2-62.4 mm. For varifocal cameras the specific value depends on the zoom. Therefore, it is necessary to make a few attempts until you can find the right value in the.

**Sensor width:** This value can be obtained from the cameras data sheet and is given as a fraction of inches (e.g. 1/1.8'' is 7.18 mm)



A table for the conversion in millimeters is available here: [https://en.wikipedia.org/wiki/Image\\_sensor\\_format](https://en.wikipedia.org/wiki/Image_sensor_format).


## AI-ROAD 3D: 3D calibration – Step 3 - Case B

This way to perform the calibration is the most comfortable but [AI-ROAD 3D: 3D calibration – Step 3 - Case A](#), p. 104 in general is more accurate.

### Draw a reference line (yellow) and give a reference length

Real size reference

Reference line with known size ▼

Draw reference line on the road 

Length reference line (m) ⓘ

3,8

Fig. 86: Draw a reference line (yellow) and give a reference length

As shown in the image below, you can draw a reference line parallel to the motion direction and give the real length in meters of the line

Be careful that the lines are drawn with accuracy, since an error in this step may negatively affect the results of the calibration.

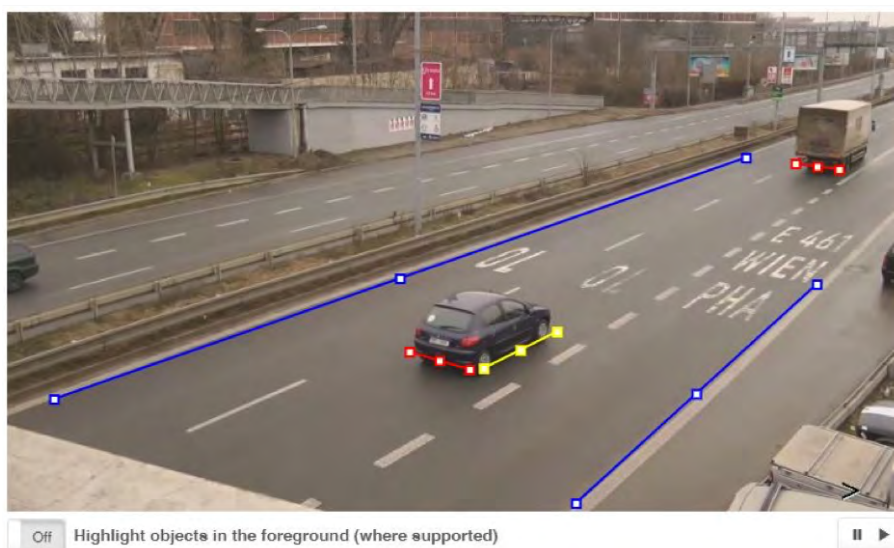


Fig. 87: Draw a reference line (yellow) and give a reference length

## AI-ROAD 3D: 3D calibration examples

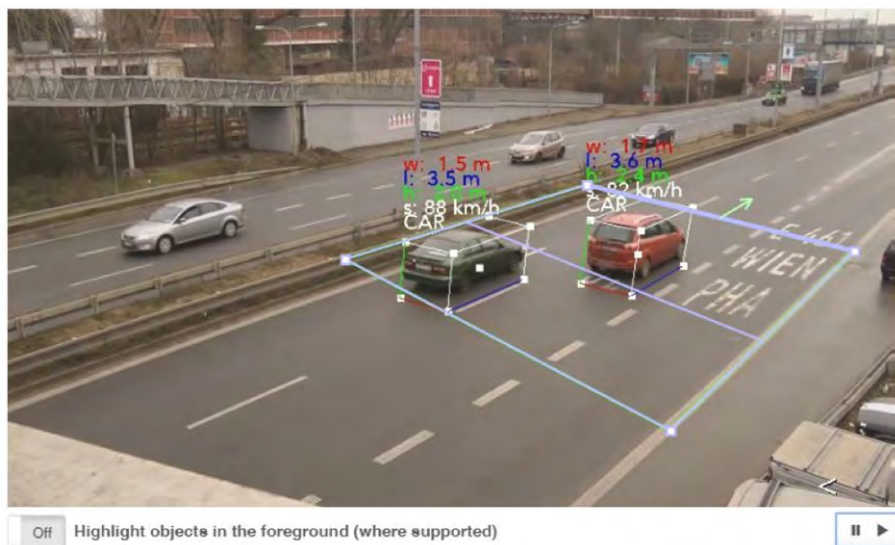


Fig. 88: AI-ROAD 3D calibration example 1

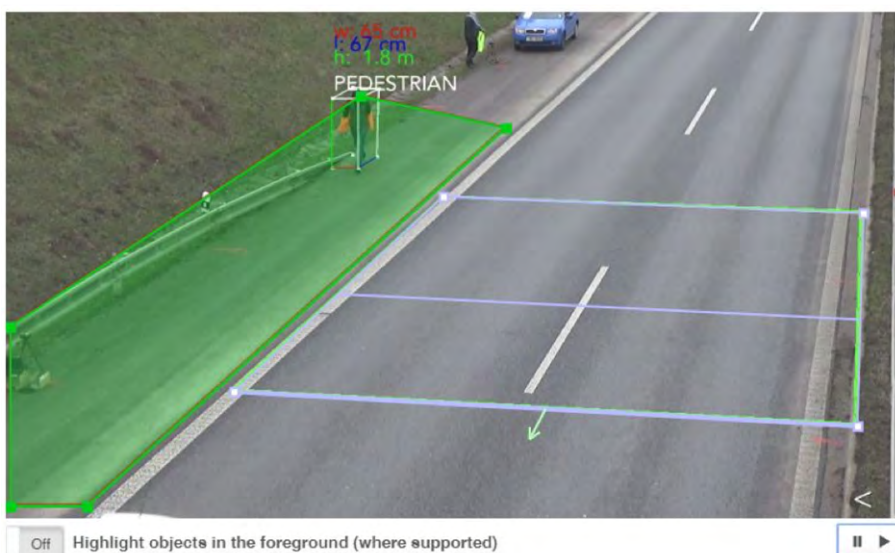


Fig. 89: AI-ROAD 3D calibration example 2

## AI-ROAD 3D: 3D - troubleshooting

The considerations reported below allow to solve calibration issues only if the camera height is correct and all reference lines have been configured correctly. Otherwise it is necessary to rectify the configuration of these items.

### Underestimation of values

Underestimation of the length, the width and the speed of the vehicle are typically due to an underestimation of the focal length. In this case **increase the value of the focal length**, remaining in the range reported on the camera datasheet.

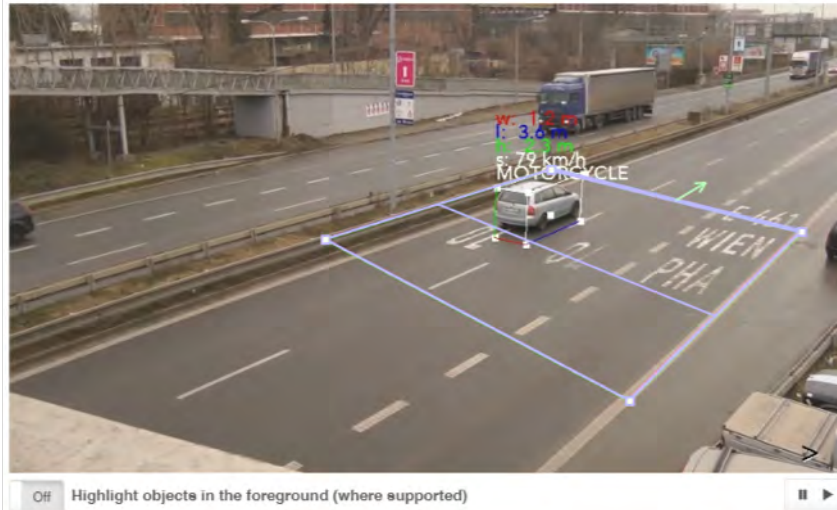


Fig. 90: AI-ROAD 3D underestimation of values

### Overestimation of values

Overestimation of the length, the width and the speed of the vehicle are typically due to an overestimation of the focal length. In this case **decrease the value of the focal length**, remaining in the range reported on the camera datasheet.

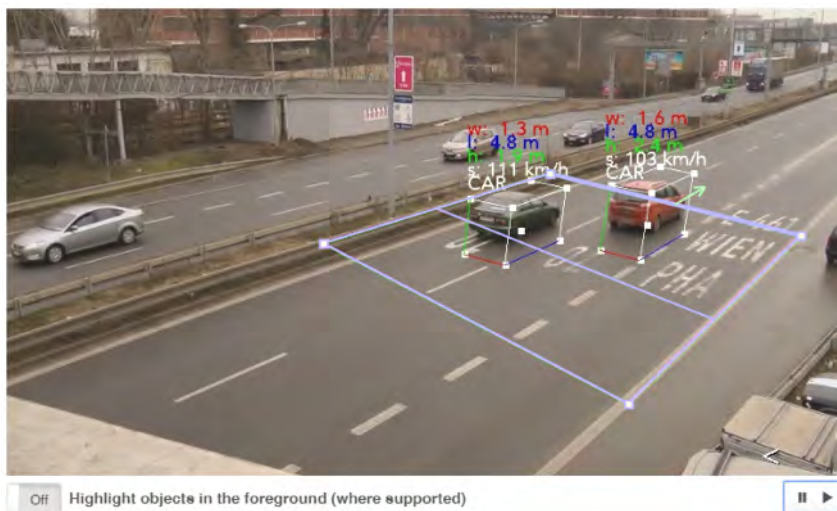


Fig. 91: AI-ROAD 3D overestimation of values

# AI-INCIDENT

AI-INCIDENT is a video analytics app for monitoring the road traffic in real-time; thus, the environmental conditions will affect the performance of the application. It is able to detect the presence of pedestrians, stopped vehicles, queuing or vehicles crossing a road in the wrong direction. It generates events that can be managed by all the notification channels.

The accuracy to be expected is under ideal environmental and installation conditions

- Recall: 90%
- Precision: 95%

In our experiments, a vehicle crossing the road in the wrong way, a stopped vehicle, a pedestrian or a queue correctly detected by AI-Incident is considered a true positive; viceversa, it is a false negative. On the other hand, all these real events not detected by the algorithm are false positives.



Fig. 92: AI-INCIDENT: configuration

## Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- There must be no fog, clouds or other moving objects whose appearance is similar to the target in the areas of interest.

- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image
- Absence of vehicles with lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The target must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the target is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The target must stay in the interested area for a time of at least 1 second.
- A vehicle must have a minimum area of 2500 pixels (e.g. 50x50), while a pedestrian must have a minimum area of 600 pixels (e.g. 15x40)s.
- The target must move at a maximum speed of half their width on the image per frame. For example, a target that is 40 pixels wide at 10 frames per second must move at a speed of no more than 20 pixels per frame, that is 200 pixel per second.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- In case of thermal cameras, the image must be not coloured but in grayscale (white for "hot" pixels, black for "cold" pixels). The camera, thermal or monocular, must be always configured in order to avoid continuous changes of brightness.

### Installation constraints

A camera usable for traffic monitoring with AI-INCIDENT must be installed as defined in [AI-TRAFFIC - camera positions, p. 96](#).





## AI-PARKING

AI-PARKING is the video analysis solution for monitoring parking areas, perimeter and non-perimeter. It assesses whether a parking spot is free or occupied. It needs information about the color, so a thermal camera is not suitable for this app. It generates events that can be managed by all the notification channels.

### AI-PARKING - camera positions

A camera usable for traffic monitoring with AI-ROAD 3D (see [AI-ROAD 3D](#), p. 97) must respect the following constraints:

1. The portion of each parking spot, without any occlusion due to other vehicles, must have minimum dimensions of 30x30px.



Fig. 93: AI-PARKING - Configuration of parking spots

# AI-PARKING

The performance to be expected is under ideal environmental and installation conditions

Parking Spot (busy or free):

- Accuracy: 85%

Parking Lot (number of spots correctly classified):

- Accuracy: 90%



Fig. 94: AI-PARKING

## Environment conditions

AI-PARKING is a video analytic app for monitoring outdoor parking areas; thus, the environmental conditions will affect the performance of the application:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- There must be no fog, clouds or other moving objects whose appearance is similar to the smoke (e.g. white powder raised by the wind) in the areas of interest.



- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of strong lights (e. g. vehicle lights) projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The target must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the target is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The target must stay in the interested area for a time of at least 10 seconds.
- The target, or a piece of it, must have a minimum area of 900 pixels (e.g. 30x30) without occlusions.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- The camera must be always configured in order to avoid continuous changes of brightness.

### Required configuration

AI-PARKING must be configured according to the following guidelines:

1. Draw a square sensor for each parking spot, being careful that every area can not be occluded by vehicles parked in different spots.
2. Specify the confidence, the latency and the inhibition for the detection of parked vehicles.
3. Configure at least one event manager to collect the events.
4. If needed, schedule the applications in specific time intervals.

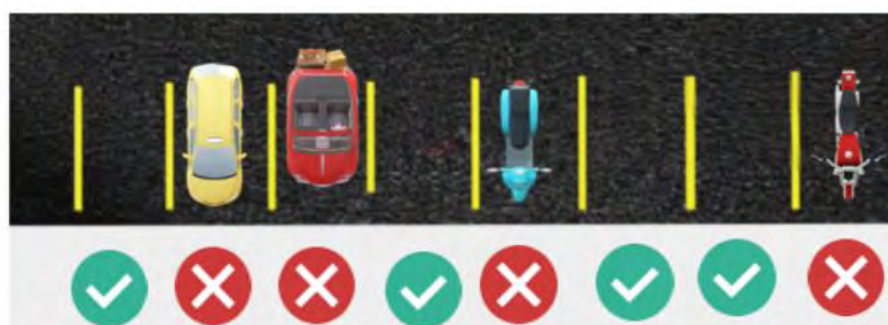


Fig. 95: Example of AI-PARKING output



## AI-BIO

AI-BIO is an app for recognizing the gender and estimating the age of a person by analyzing the face. The plug ins also provides information about the persistence time of an individual in front of the camera and it is able to send notifications useful for digital signage. It generates events that can be managed by all the notification channels.

### AI-BIO - camera positions

- Install the camera in front of the person at a recommended height of 1.8 m.
- Install the camera in a place that attracts the glance of the person, in order to obtain a frontal view of the face.
- Install the camera at a distance that allows to obtain the face on the image with an horizontal resolution at least of 30 pixels.
- Install the camera with a good lighting in order to obtain well visible facial landmarks

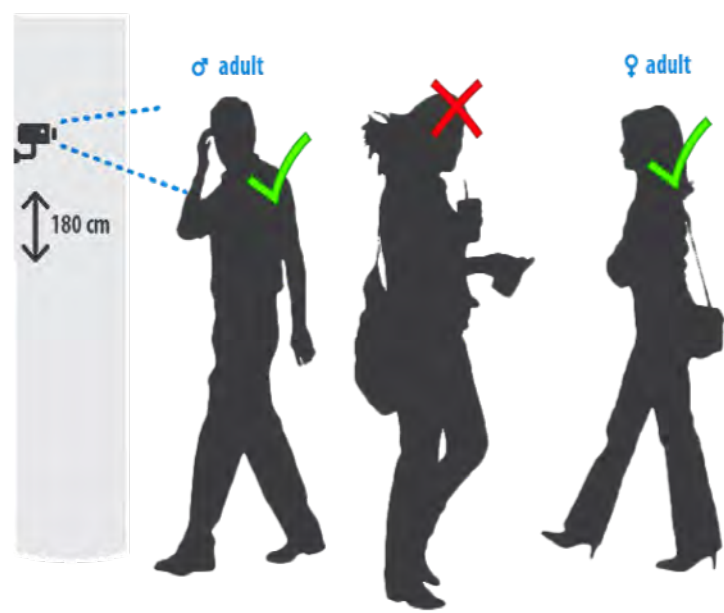


Fig. 96: Camera position

# Recommended distances

Distance (cm)	Real width (cm)	Pixel / cm	Face width (cm)
100	140,0	2,3	37
200	280,1	1,1	18
300	420,1	0,8	12
400	560,2	0,6	9
500	700,2	0,5	7
600	840,2	0,4	6
700	980,3	0,3	5
800	1120,3	0,3	5
900	1260,4	0,3	4
1000	1400,4	0,2	4

# AI-BIO

AI-BIO is an app for recognizing the gender and estimating the age of a person by analyzing the face. The plug ins also provides information about the persistence time of an individual in front of the camera and it is able to send notifications useful for digital signage. It generates events that can be managed by all the notification channels.

AI-BIO is a video analytic app optimized to analyze the faces in typical retail scenarios; of course, the position of the camera and the environmental conditions will affect the performance of the application.

The performance to be expected is under ideal environmental and installation conditions

Gender recognition:

- Accuracy: 90%

Age estimation:

- MAE (Mean Average Error): 10 years
- Accuracy (age groups child, young, adult, elder): 80%

## Environment conditions

The position of the camera and the environmental conditions affect the performance of the application. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x180, 320x240.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- Absence of stationary or slow-moving people for long periods in the counting area (e.g. Sales people that encourage customers to enter).
- There must be no other moving objects whose appearance is similar to the people in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of vehicles with lights projected in areas of interest.

- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The people must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The people must have a minimum area of 600 pixels (e.g. 20x30, 15x40, ...).
- The floor must be a predominantly non-reflective surface.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

## AI-OCCUPANCY

AI-OCCUPANCY is the video analysis app for the determination of the occupancy percentage of one or more areas inside the scene, thus allowing to distinguish between the most visited areas (hot spots) and the less crowded ones (dead areas) in indoor and outdoor environments. It generates periodic events that can be managed by AI-Dash, AI-Dashboard embedded, FTP servers and Third-Party servers. It can be used also with thermal cameras.

### AI-OCCUPANCY - camera positions

A camera that can be used to determine the occupancy percentage using AI-OCCUPANCY must respect the following constraints:

- Make sure the size of the targets (people, vehicles, animals) have a minimum area of 100 pixels.
- If necessary, the camera should be mounted with external illuminators, to distinguish the targets with natural or artificial illumination.

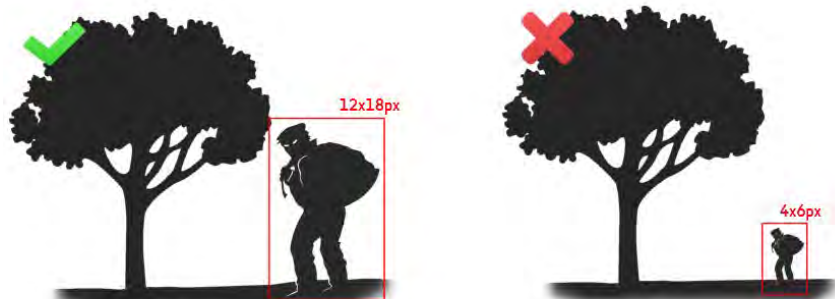


Fig. 97: Camera positions

## AI-OCCUPANCY



Fig. 98: AI-OCCUPANCY

### Environment conditions

AI-OCCUPANCY is a video analytic app for monitoring outdoor parking areas; thus, the environmental conditions will affect the performance of the application:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x240, 320x180.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.



- There must be no fog, clouds or other moving objects whose appearance is similar to the smoke (e.g. white powder raised by the wind) in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of strong lights (e. g. vehicle lights) projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The target must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the target is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- In case of thermal cameras, the image must be not colored but in grayscale (white for "hot" pixels, black for "cold" pixels). The camera, thermal or monocular, must be always configured in order to avoid continuous changes of brightness.

### **Required configuration**

AI-OCCUPANCY must be configured according to the following guidelines:

1. Draw a sensor.
2. Configure the sensors so as to include only "walkable" areas, namely those areas of the image where people, objects or animals may be present. The presence of inanimate objects in the areas of interest, in fact, causes an inevitable underestimation of the occupancy percentage.
3. Configuration of the observation period (please consult the manual for further information).
4. IConfigure the parameters for background updating, for the application of the morphological operators, for detecting brightness changes and for removing shadows, in order to detect the objects of interest.

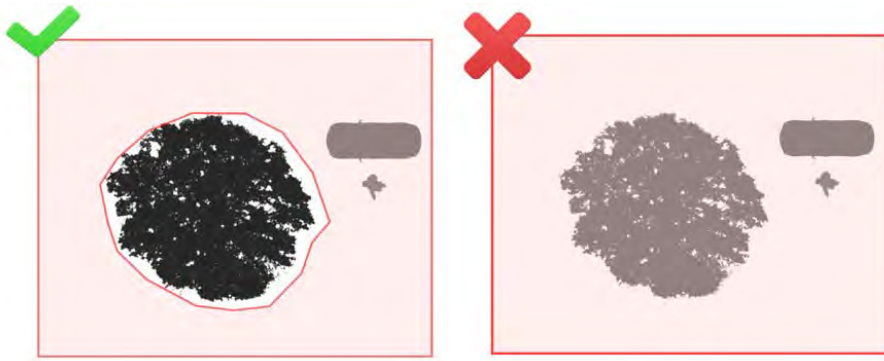


Fig. 99: Example of correct and wrong sensor positioning

## AI-OVEROCCUPANCY

AI-OVEROCCUPANCY is the video analysis app for the detection of overoccupancy in one or more areas inside the scene in indoor and outdoor environments. It generates events that can be managed by all the event notifiers. It can be used also with thermal cameras.

### AI-OVEROCCUPANCY - camera positions

A camera that can be used to determine the occupancy percentage using AI-OVEROCCUPANCY must respect the following constraints:

- Make sure the size of the targets (people, vehicles, animals) have a minimum area of 100 pixels.
- If necessary, the camera should be mounted with external illuminators, to distinguish the targets with natural or artificial illumination.

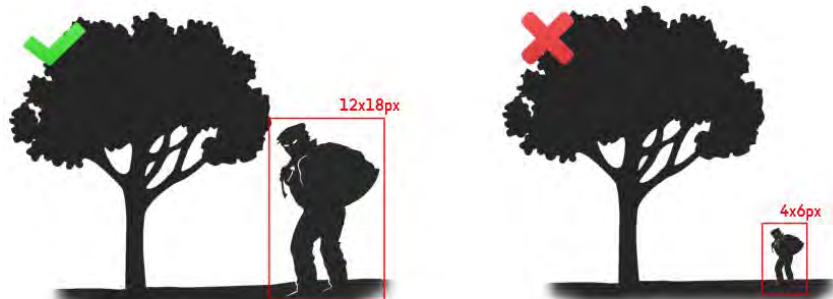
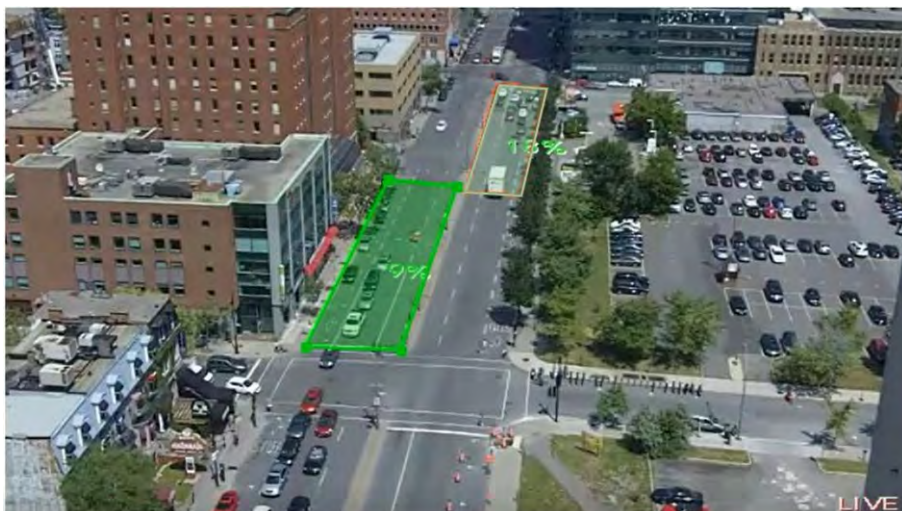


Fig. 100: Camera positions

## AI-OVEROCCUPANCY



AI-OVEROCCUPANCY

### Environment conditions

AI-OVEROCCUPANCY is a video analytic app for monitoring outdoor parking areas; thus, the environmental conditions will affect the performance of the application:

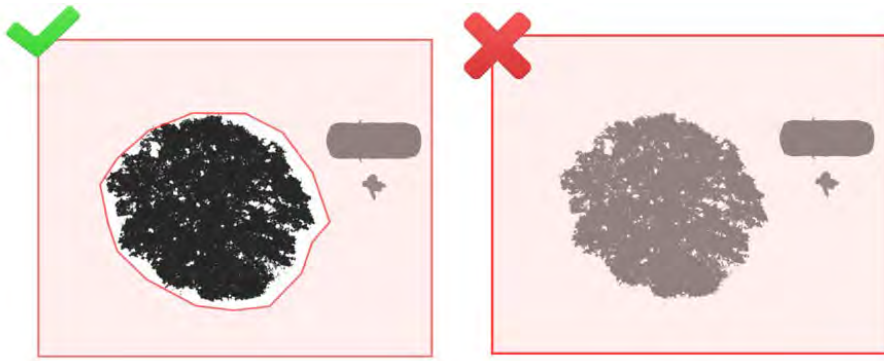
- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x240, 320x180.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.

- There must be no fog, clouds or other moving objects whose appearance is similar to the smoke (e.g. white powder raised by the wind) in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of strong lights (e. g. vehicle lights) projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The target must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the target is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- In case of thermal cameras, the image must be not coloured but in grayscale (white for "hot" pixels, black for "cold" pixels). The camera, thermal or monocular, must be always configured in order to avoid continuous changes of brightness.

### Required configuration

AI-OVEROCCUPANCY must be configured according to the following guidelines:

1. Draw a sensor.
2. Configure the sensors so as to include only "walkable" areas, namely those areas of the image where people, objects or animals may be present. The presence of inanimate objects in the areas of interest, in fact, causes an inevitable underestimation of the occupancy percentage.
3. Configuration of the observation period (please consult the manual for further information).
4. IConfigure the parameters for background updating, for the application of the morphological operators, for detecting brightness changes and for removing shadows, in order to detect the objects of interest.

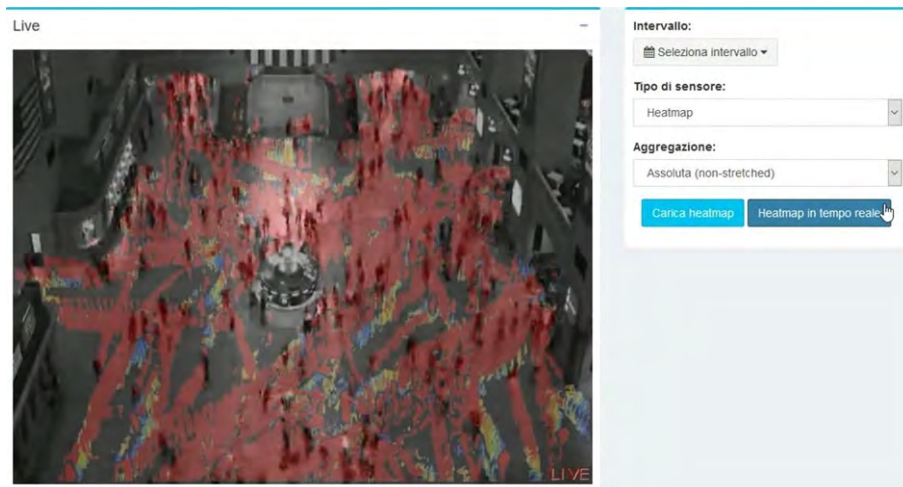


Example of correct and wrong sensor positioning

## AI-HEAT

AI-HEAT is an app for classifying the areas depending on the time spent by moving people inside the areas of interest, thus allowing to distinguish between the most visited areas (hot spots) and the less crowded ones (dead areas).in indoor and outdoor environments. It generates periodic heat maps that can be managed by AI-Dash and AI-Dash Embedded. It can be used also with thermal and fisheye cameras.

# AI-HEAT



AI-HEAT

## Environment conditions

AI-HEAT is a video analytic plugin able to compute the heat map in indoor and outdoor environments. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x240, 320x180.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- There must be no fog, clouds or other moving objects whose appearance is similar to the smoke (e.g. white powder raised by the wind) in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of strong lights (e. g. vehicle lights) projected in areas of interest.



- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The target must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the target is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- In case of thermal cameras, the image must be not coloured but in grayscale (white for “hot” pixels, black for “cold” pixels). The camera, thermal or monocular, must be always configured in order to avoid continuous changes of brightness.

If necessary, the camera must be installed with external illuminators that make it possible to distinguish the targets in all natural or artificial lighting conditions.

### Required configuration

AI-HEAT must be configured according to the following guidelines:

1. Draw non interest areas, so as to exclude regions in constant motion (screen, cash and so on).
2. Configuration of the time interval between consecutive events.
3. Configuration of the heating and cooling time.
4. Configure the parameters for background updating, for the application of the morphological operators, for detecting brightness changes and for removing shadows, in order to detect the objects of interest.



## AI-SPILL

AI-SPILL is an app for detecting falls in indoor environments like hospitals or apartments. It generates events that can be managed by all the notification channels. Since the plugin uses information about the color, thermal cameras are not allowed.

## AI-SPILL

The performance to be expected is under ideal environmental and installation conditions

- Recall: 90%

### Environment conditions

AI-Spill is a video analytic plugin able to detect falls in indoor environments. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360, 640x480, 320x240, 320x180.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.

- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- There must not be moving objects whose appearance is similar to the target in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of strong lights projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The people must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the people are similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.
- The target must stay in the interested area for a time of at least 5 seconds.
- The target must have a minimum area of 600 pixels (e.g. 15x40).
- The target must move at a maximum speed of half their width on the image per frame. For example, a target that is 40 pixels wide at 10 frames per second must move at a speed of no more than 20 pixels per frame, that is 200 pixel per second.
- The floor must be a predominantly non-reflective surface.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.
- The camera must be always configured in order to avoid continuous changes of brightness.

### Required configurations

AI-SPILL must be configured according to the following guidelines:

1. Draw a sensor
2. If you want to avoid multiple alarms for the same event, increase the inhibition time
3. Configure the entrance areas so as to consider only the objects that pass through specific areas of the image
4. Configure the minimum and maximum pixel size of an object of interest
5. Calibrate the camera by correctly specifying height, horizontal angle of view and vertical angle of view

6. Calibrate the algorithm by correctly specifying the inclination angle of the camera and the training samples
7. Configure the parameters for background updating, for the application of the morphological operators, for detecting brightness changes and for removing shadows, in order to detect the objects of interest
8. Configure at least one event manager to collect the events
9. If needed, schedule the applications in specific time intervals



## AI-SMOKE

AI-SMOKE is an app for the detection of smoke in outdoor environments, such as urban forests, parks and so on. It generates events that can be managed by all the notification channels. It uses information about the color, so it cannot be used with thermal cameras; for the same reason, the performance may decrease during the night.

## AI-SMOKE

The video-wise performance to be expected is under ideal environmental and installation conditions

- Recall: 95%
- Precision: 75%

Video-wise means that a smoke detected in a video in which there is smoke is considered a true positive; viceversa, a smoke not detected it is considered a false negative. On the other hand, a smoke detected in a video where there is not a smoke is considered a false positive; viceversa, a smoke not detected is considered a true negative.

Recall and Precision have been computed following this experimental protocol.



AI-SMOKE

## Environment conditions

AI-SMOKE is a video analytic plugin able to detect falls in indoor environments. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360 or 640x480.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- There must be no fog, clouds or other moving objects whose appearance is similar to the smoke (e.g. white powder raised by the wind) in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of strong lights (e. g. vehicle lights) projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The smoke must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the smoke is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.



- The smoke must stay in the interested area for a time of at least 5 seconds.
- The smoke must have a minimum area of 600 pixels (15% of the cell of the grid).
- The smoke must move at a maximum speed of half their width on the image per frame. For example, a smoke that is 40 pixels wide at 10 frames per second must move at a speed of no more than 20 pixels per frame, that is 200 pixel per second.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

### **Required configuration**

AI-SMOKE must be configured according to the following guidelines:

1. Draw a sensor and configure a latency time of at least 5 seconds.
2. If you want to avoid multiple alarms for the same smoke, increase the inhibition time.
3. Enable the flag “Verify smoke”.
4. Configure the movement threshold (recommended value 0.15) and the classification sensitivity (recommended value 0.85).
5. Configure the parameters for background updating, for the application of the morphological operators, the RGB threshold (recommended value 18) and the saturation threshold (recommended value 51) to detect moving objects like smoke.
6. Configure at least one event manager to collect the events.
7. If needed, schedule the applications in specific time intervals



## AI-FIRE

AI-FIRE is an app for the detection of flames in outdoor environments, such as urban forests, parks and so on. It generates events that can be managed by all the notification channels. It uses information about the color, so it cannot be used with thermal cameras; for the same reason, the performance may decrease during the night.

## AI-FIRE

The video wise performance to be expected is under ideal environmental and installation conditions

- Recall: 95%
- Precision: 80%

Video-wise means that a flame detected in a video in which there is flame is considered a true positive; viceversa, a flame not detected it is considered a false negative. On the other hand, a flame detected in a video where there is not a flame is considered a false positive; viceversa, a flame not detected is considered a true negative.

Recall and Precision have been computed following this experimental protocol.



AI-FIRE

## Environment conditions

AI-Spill is a video analytic plugin able to detect falls in indoor environments. Performance is best under the following conditions:

- The image must not present flickering, severe noise or artifacts.
- Image must have a resolution of 640x360 or 640x480.
- Rotating (PTZ) security cameras are supported only if they are not moved when the application is enabled. If the camera is moved, the application must be reconfigured.
- Absence of occlusions (E. g. Trees, pillars, buildings, furniture elements etc.) that do not allow to see the people.
- Absence of conditions of high crowding or stopped people that do not allow to count the individuals.
- There must be no fog, clouds or other moving objects whose appearance is similar to the smoke (e.g. white powder raised by the wind) in the areas of interest.
- Camera lens must not be dirty, wet or covered in rain or water drops. Camera lens must not be steamy.
- Absence of "waving objects" (e.g. Meadow with tall grass, trees, sliding doors, etc.) or any other type of disturbance that causes the continuous modification of the images (moving pixels) in the areas of interest.
- Camera placement must be stable and solid in a way that wind or external disturbances of other types will cause movement of the camera that appears on the image.
- Absence of strong lights (e. g. vehicle lights) projected in areas of interest.
- Correct exposition of the camera: camera must not be in backlight, the framed area must not have heterogeneous illumination, i.e. partially indoor or partially outdoor. In general, no areas to be monitored must be almost white or almost black, i.e. the dynamic range must be sufficient to correctly show detail of objects in the image. If necessary, the camera must be installed with external illuminators that make it possible to distinguish the people in all natural or artificial lighting conditions.
- The smoke must have a sufficient dissimilarity from the background, i.e. there is no explicit camouflage, where the smoke is similar to the background in color and texture. Sufficient dissimilarity means at least a color difference of at least 5% or a brightness difference of at least 10%.

- The smoke must stay in the interested area for a time of at least 5 seconds.
- The smoke must have a minimum area of 600 pixels (15% of the cell of the grid).
- The smoke must move at a maximum speed of half their width on the image per frame. For example, a smoke that is 40 pixels wide at 10 frames per second must move at a speed of no more than 20 pixels per frame, that is 200 pixel per second.
- The scene must be predominantly non-reflective.
- No hard lights must be present that cast shadows in a way that the background brightness is reduced to less than 50% of the original value in the image.

### **Required configuration**

AI-FIRE must be configured according to the following guidelines:

1. Draw a sensor and configure a latency time of at least 5 seconds.
2. If you want to avoid multiple alarms for the same smoke, increase the inhibition time.
3. Enable the flag “Verify fire”.
4. Configure the verification sensitivity (recommended value 0.85).
5. Configure the parameters for background updating, for the application of the morphological operators, and the fire detection threshold (recommended value 40) to detect moving objects like flames.
6. Configure the minimum and the maximum size in pixels of a flame.
7. if you are framing a scene with an extended depth of field, calibrate the camera and the algorithm and configure the minimum and maximum real size of a flame.
8. Configure at least one event manager to collect the events.
9. If needed, schedule the applications in specific time intervals.



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