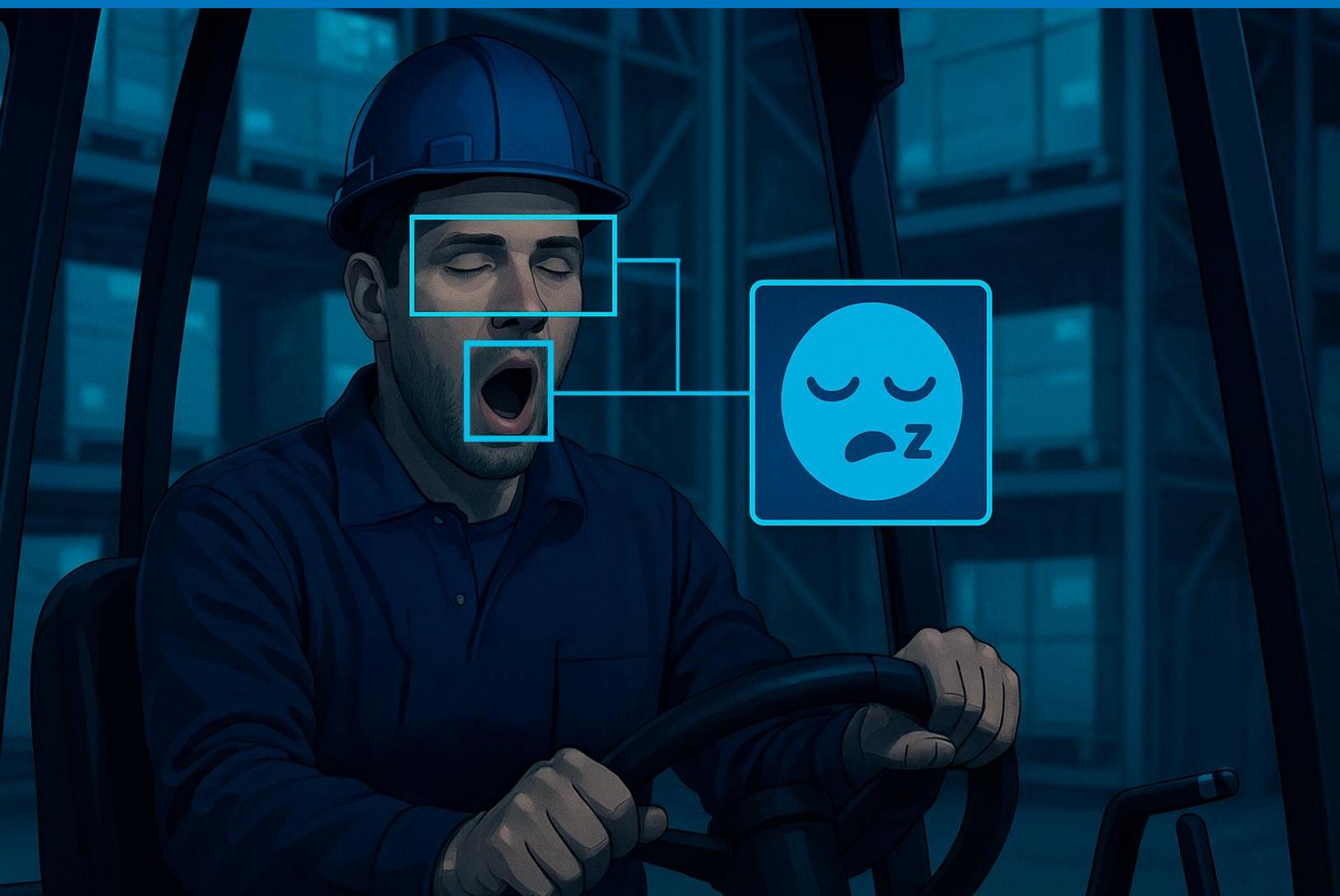
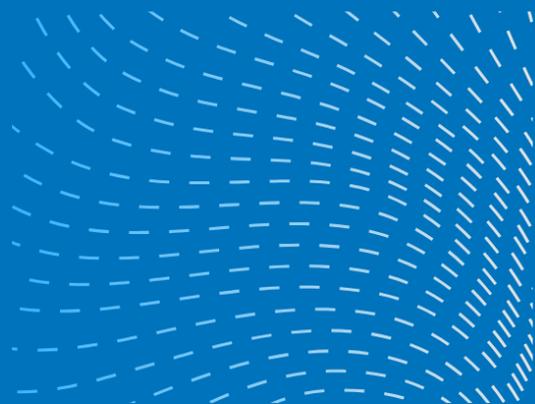


IPXAnalytics
Datasheet

Fatigue Module



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IPExtreme

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Fatigue Module

Compatibility: IPXAnalytics PRO, 2.0 or higher.

IPXAnalytics

IPXAnalytics is a software that uses artificial intelligence to learn and detect events from surveillance cameras. The artificial intelligence is based on neural networks and LLMs, which are algorithms designed to mimic the behavior of the human brain. Compared to existing video analytics software on the market today, IPXAnalytics significantly reduces the number of false alarms.

Fatigue Module

Our fatigue detection module offers advanced capabilities to monitor operator alertness, ensuring safety, efficiency and productivity in critical work environments. Key highlights include:

Eye Status Analysis : Our system uses advanced algorithms to detect prolonged eye closure, indicating possible operator drowsiness or fatigue.

Mouth Opening Detection : Our technology identifies prolonged yawning, a clear indicator of fatigue and drowsiness that can compromise operational safety.

Head Position Monitoring : Through real-time video analysis, we can identify abnormal head movements, such as tilts, which may indicate loss of concentration or microsleeps.

Cell Phone Usage Detection : Our technology identifies when the operator is handling mobile devices during operation, preventing distractions that can compromise safety and productivity.

Cigarette Smoking Identification : The system is capable of detecting cigarette smoking during work, ensuring compliance with occupational health and safety policies.

Customization for specific needs : We offer the flexibility to adapt our software to meet each customer's specific needs, whether it's to monitor different types of environments, integrate with existing systems, or adapt to particular environmental conditions.

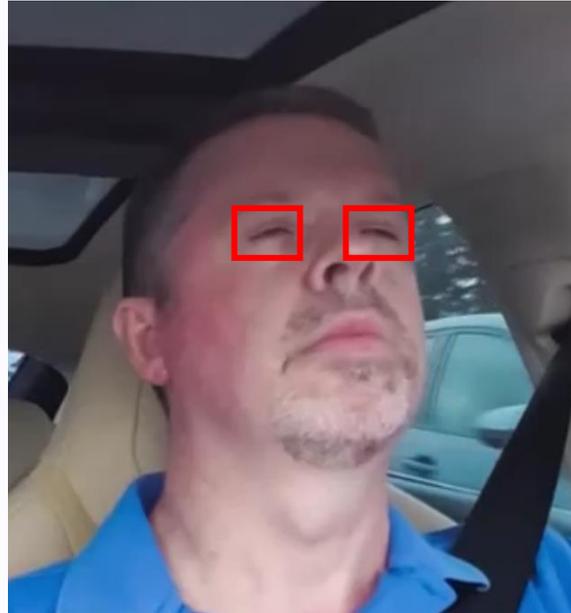
Additional benefits:

- Proactive prevention of accidents caused by fatigue
- Significant reduction of operational risks
- Improved operator performance and productivity
- Compliance with occupational safety standards
- Data collection for analysis and continuous improvement of security protocols

Feature Examples

Eye Condition Analysis

The software detects the operator's eyes, identifying whether they are open or closed. Using this information, IPX can configure logic that triggers alarms if the eyes remain closed for a certain period of time. This strategy allows for the detection of possible signs of fatigue or drowsiness, contributing to operational safety



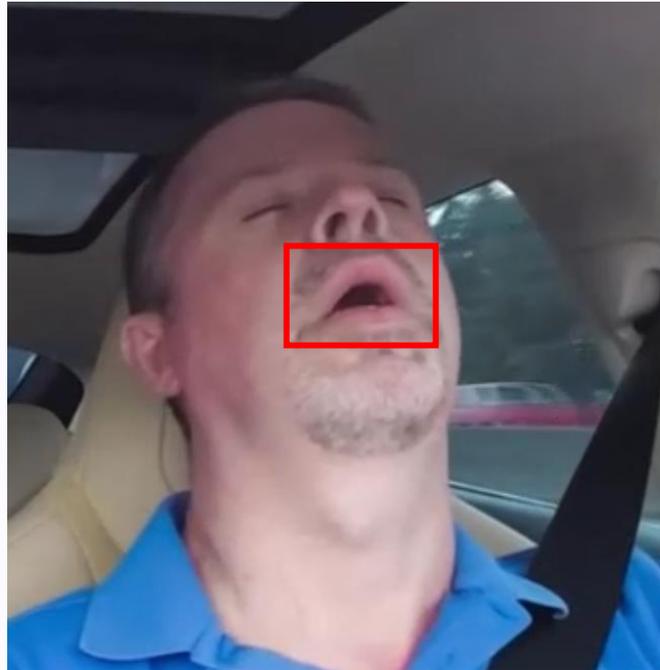
Head Position Monitoring

The system detects changes in the position and movements of the operator's head. Sudden changes, prolonged tilts or movements that may indicate fatigue or loss of concentration, triggering alerts to supervisors or the operator himself.



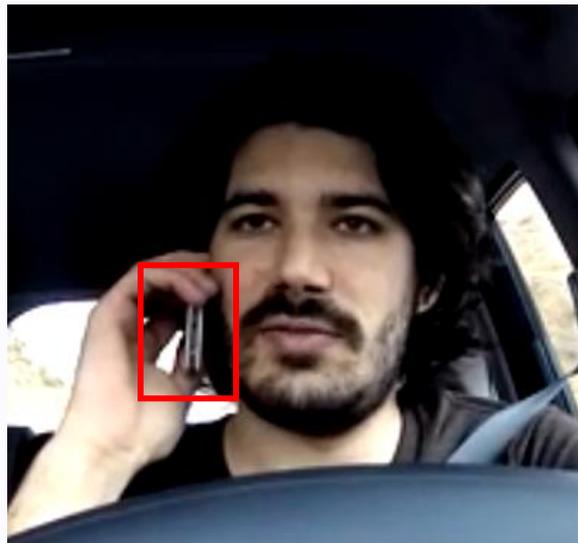
Mouth Opening Detection

The software identifies mouth opening patterns that indicate yawning. This feature complements the analysis of eyes and head position, providing a more accurate diagnosis of the operator's level of fatigue.



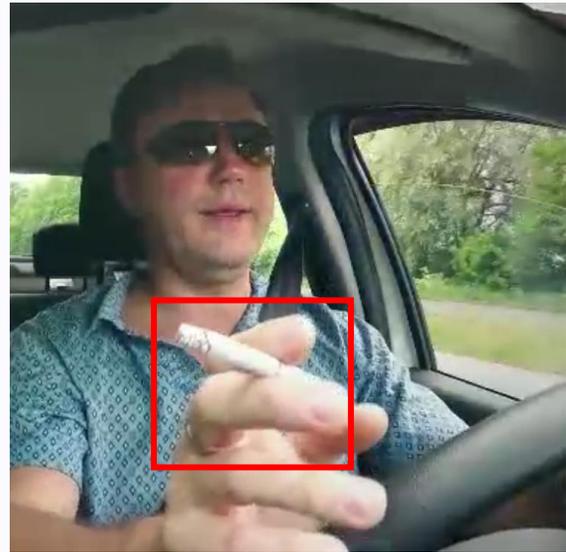
Cell Phone Usage Detection

The software identifies when an operator is using mobile devices during activities that require full attention. This feature is especially important for professional drivers, heavy machinery operators and workers in high-risk environments.



Cigarette Consumption Identification

Our solution detects cigarette use during work, enabling strict compliance with health and safety policies. The system can be configured to issue real-time alerts and record incidents for later analysis.

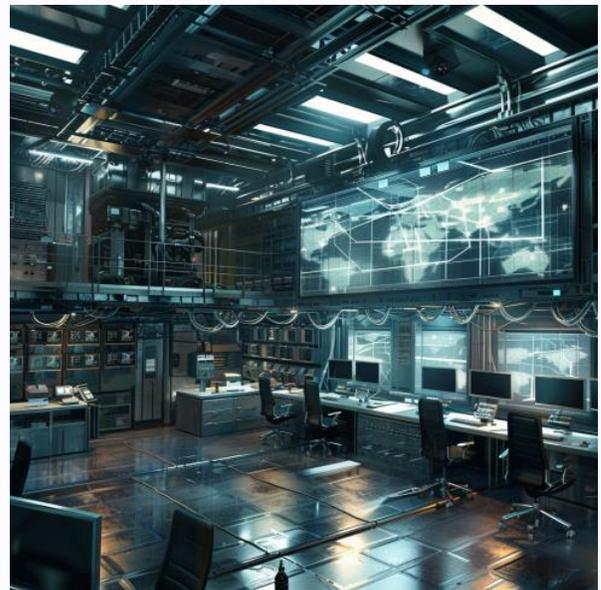


Integration

The software has an HTTP REST API that allows integration with any partner system. The software is integrated with the market-leading VMSs: Digifort, D-Guard, Milestone and Avigilon.

Please check with our team about any additional licenses required for third-party software integrations.

For more information: www.ipextreme.com.br



Customizations

In addition to the various features mentioned here, the software can also assist in numerous other situations. It is designed to be customized to meet the customer's needs. For example, in a production environment, the software can identify errors and critical failures in a specific part. To request a customization proposal, contact us on our website: www.ipextreme.com.br.

Limitations and considerations

We understand the importance of reliability in critical applications. Therefore, it is crucial to note that no AI software can guarantee 100% accuracy. Our solution offers robust and fast detection, but we always recommend maintaining backup systems and additional safety protocols to ensure a comprehensive response in emergency situations.

IPXAnalytics offers demo licenses and we recommend selling them to the customer only after successful testing in the desired environment.

Technical Sheet

Examples and descriptions of objects:

Objects

The Fatigue Module can identify these objects:

- olho_aberto
- olho_fechado
- face_frontal
- face_lateral
- face_baixa
- face_alta
- boca_normal
- boca_rindo
- bocejo
- cigarro
- celular

olho_aberto

The open eye object is an essential component of the Fatigue Module that monitors the operator's eye opening status. The software continuously analyzes the degree of eye opening. This detection is essential to determine the operator's basic level of attention, serving as a reference for identifying deviations that may indicate the onset of fatigue. The system uses algorithms to accurately measure the visible area of the eye. For effective detection, it is recommended that the camera be positioned in front of the operator's face, with adequate lighting.



olho_fechado

The closed eye object allows the system to identify when the operator's eyes are completely closed. The software monitors the duration of eye closure. This detection is crucial for the algorithm, which checks the proportion of time the eyes remain closed in a given interval, being one of the most reliable indicators of fatigue. The system can be configured to issue alerts when abnormal eye closure patterns are detected, allowing preventive interventions before fatigue compromises safety. Detection accuracy is optimized when the camera has a clear, frontal view of the operator's eyes.



face_frontal

The face frontal object is used to determine when the operator's face is positioned frontally in relation to the camera. This orientation is considered the ideal operating state, allowing maximum effectiveness in detecting all other facial parameters. For optimal operation, the camera should be positioned directly in front of the operator, preferably at eye level and at a distance that captures the entire face clearly.



face_lateral

The side face object monitors when the operator's face is oriented sideways, which may indicate distraction or lack of attention to the primary task. The software detects when the operator looks away from critical instruments or the work area for prolonged periods. This detection is particularly important in operations that require constant vigilance, such as driving vehicles, boats or monitoring control panels. The system can be configured to treat brief sideways rotations as normal, only issuing alerts when the pattern becomes prolonged, indicating possible fatigue or inattention. Detection accuracy is maximized with a camera positioned centrally in relation to the operator's natural field of view.



face_baixa

The lowered face object identifies when the operator's face is tilted downwards, a classic sign of drowsiness or microsleep. The software detects the head tilt and its duration. This detection is especially relevant on night shifts.



face_alta

The raised face object allows the system to detect when the operator's face is tilted upward, which may indicate fatigue or attempts to combat drowsiness. The software monitors head elevation and its persistence over time. The system can be configured to send an alert when prolonged head elevation is detected. For accurate identification, the camera should be positioned in front of the operator, preferably at natural eye height when in proper posture.



boca_normal

The normal mouth object establishes the operator's baseline oral expression pattern, characterized by relaxed and slightly closed lips during normal operation. The software uses this state as a comparative reference to identify significant deviations such as yawning. For effective detection, the camera must provide a clear, frontal view of the lower face, with sufficient illumination to distinguish lip contours even in operators with diverse facial features.



boca_rindo

The smiling mouth object identifies smiling or laughing expressions on the operator. This detection complements the analysis, serving as a counterpart to the yawn object. For best effectiveness, the camera should capture the entire facial region, allowing integrated analysis of expressions.



bocejo

The yawning object is dedicated to the accurate detection of yawns, one of the most obvious indicators of progressive fatigue. The software analyzes the characteristic mouth opening, its prolonged duration and specific facial movement patterns that accompany yawning. The frequency and intensity of yawns are valuable metrics for quantifying the level of operator fatigue, allowing preventive interventions before severe drowsiness occurs. For effective detection, the camera must be positioned so that it clearly captures the entire region of the face, with an emphasis on the lower area.



cigarro

The cigarette object is used to identify when an operator is smoking while working. This detection helps ensure compliance with health and safety policies in the workplace. For optimal operation, the camera must have a good view of the operator's face and hands. The system can be configured to issue immediate alerts when cigarette use is detected in prohibited areas.



cellular

The phone object allows the system to detect when an operator is using or handling a cell phone during their activities. This detection is essential to identify risky behaviors and distractions that can compromise safety. For greater accuracy, it is recommended that the camera has a good view of the operator's hands and lap area.



Recommended minimum sizes for detection

A common question is about where the camera should be installed for optimal detection. It is difficult to say with complete certainty because cameras can have different lenses, angles and zoom levels. The most important factors are the size of the object in the image and its visibility. The table below indicates the recommended minimum size of the object in the image as a percentage. The percentage refers to the relative size of the object, as there can be different types of resolutions and scaling. So when we say that an object is 1% in size, we are indicating that, for example, in a 512x512 image, the object would be 5.12 pixels by 5.12 pixels. See the next chapter for instructions on how to check the size of the object directly in IPXAnalytics.

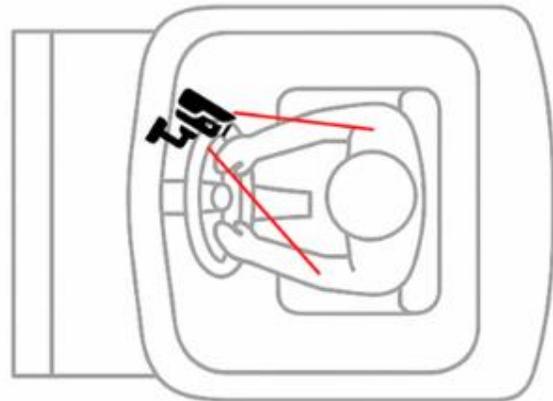
Object	Minimum percentage size for identification
eye_open	0.2%
eye_closed	0.2%
face_front	12.5%
face_side	12.5%
face_down	12.5%
face_high	12.5%
normal_mouth	0.2%
laughing_mouth	0.2%
yawn	0.2%
cigarette	0.2%
cellular	0.2%

Ideal camera positioning:

**Front camera
positioned at face
height**

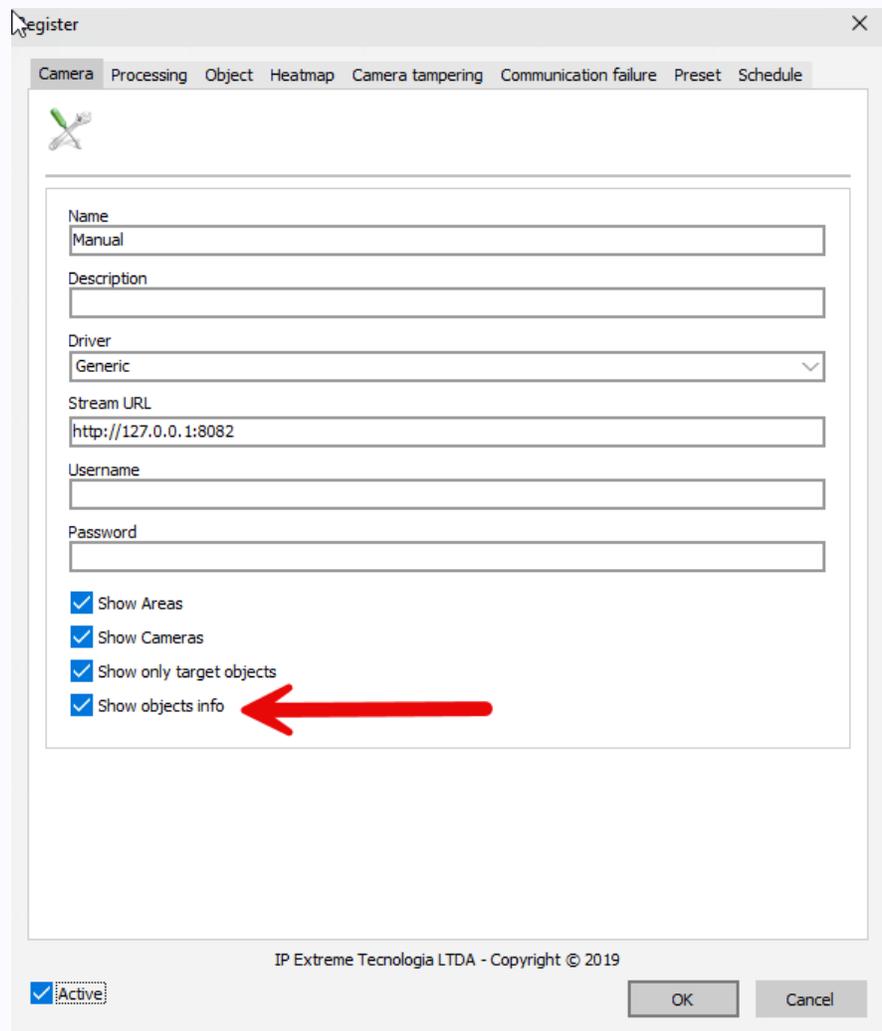


**Front camera with
maximum lateral
angle of 30° (degrees)**



How to identify the size of an object

In IPXAnalytics, you can view the live image in two ways: using the debug mode or clicking View in the admin client. When registering a camera, in the first tab, check the "show object information" option. This option will display the size of each object detected in the image and its orientation (vertical or horizontal).



The screenshot shows a 'Register' dialog box with the following fields and options:

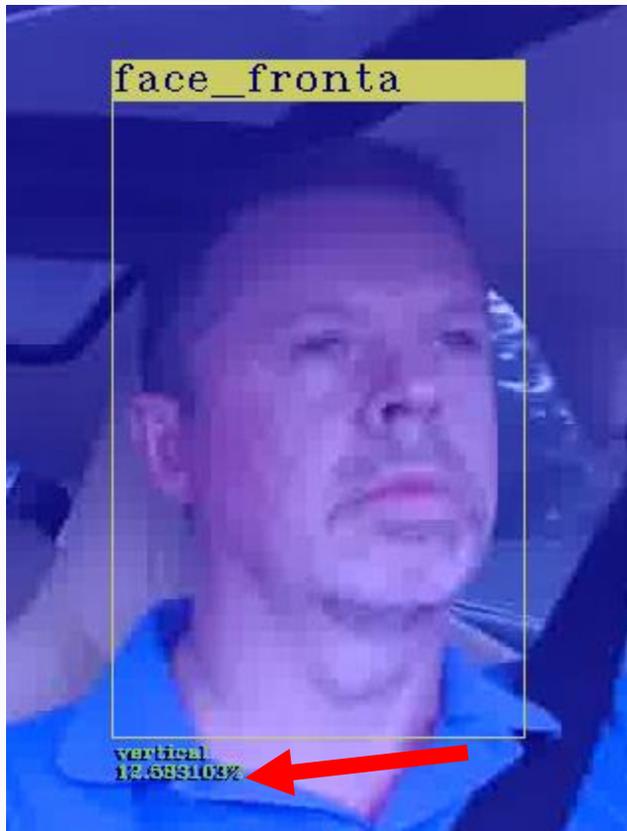
- Camera Processing Object Heatmap Camera tampering Communication failure Preset Schedule
- Name: Manual
- Description: (empty)
- Driver: Generic
- Stream URL: http://127.0.0.1:8082
- Username: (empty)
- Password: (empty)
- Show Areas
- Show Cameras
- Show only target objects
- Show objects info

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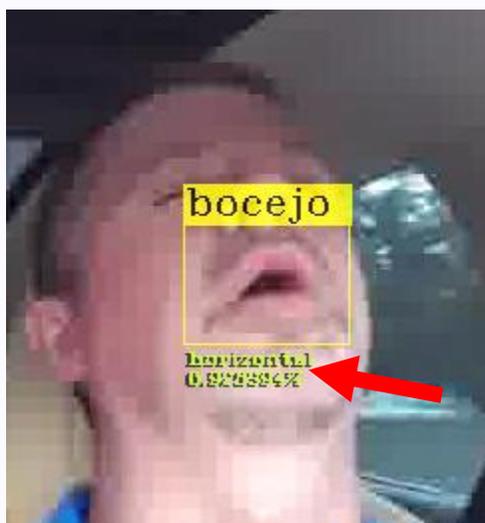
Active OK Cancel

Examples:

A person detected in the image with a total size of 4.0%.



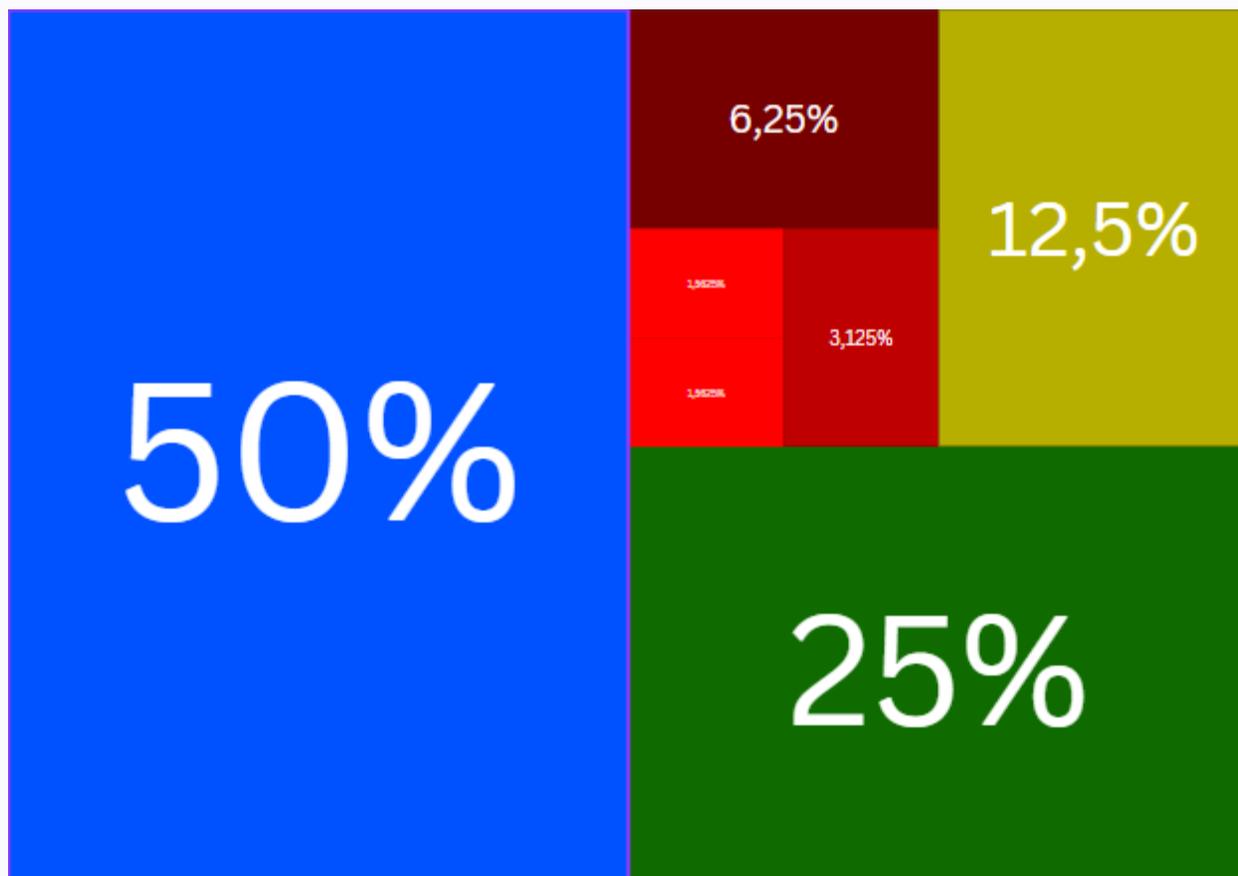
Face_front detected in the image with a size of 12.58%.



yawn detected in the image with a size of 0.92%.

The image was created to visually illustrate the proportion of an object in relation to the total screen. It divides the space into different percentage areas, making it easier to understand the minimum size required for computer vision software to accurately recognize an object.

Each rectangle represents a specific fraction of the total screen, starting at 50% and successively subdividing each area into halves. This way, the user can intuitively understand how different sizes affect detection and what minimum dimensions are recommended for effective recognition.



Optimal camera resolution for object recognition

For effective object recognition, camera resolution is essential. The minimum recommended resolution for optimal performance is **512x512**. This resolution provides enough detail for accurate detection and classification while balancing computational efficiency. Higher resolutions, such as 1080p or 4K, require more processing power without significantly improving accuracy and can lead to diminishing returns. On the other hand, lower resolutions can result in blurry or distorted images, making object recognition more difficult. Therefore, a resolution of 512x512 is the ideal minimum for reliable and efficient object detection.

Low Resolution vs High Resolution Comparison:

