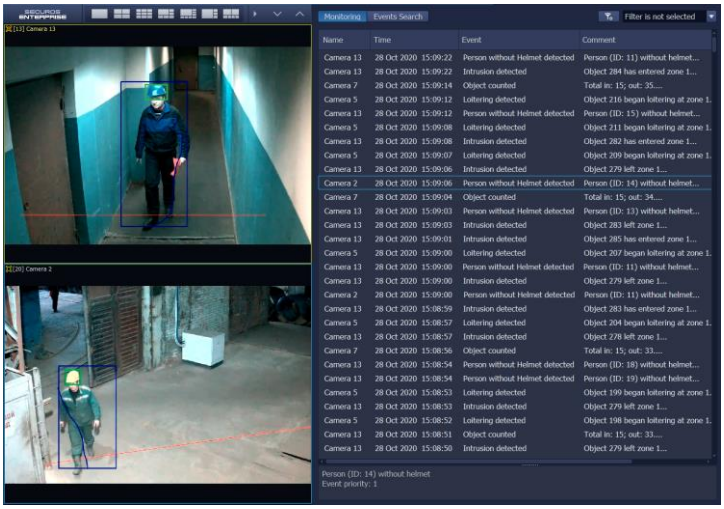
SecurOS™ Helmet Detection

Protective helmet detection based on neural network technologies



Working in such places as construction sites, manufacturing plants, and coal mines - requires strict compliance with staff safety rules, including the usage of protective equipment. One of the most important protective equipment is the helmet / hardhat.

The SecurOS™ Helmet Detection module is a specialized solution for monitoring and increasing industrial safety. The solution identifies persons from a video stream and detects if they are wearing a protective helmet / hardhat. If there is no helmet detected on their head, the solution will generate an alarm and send real-time alerts (email, SMS, audio notifications, etc…) to all required supervisors.

KEY ADVANTAGES

- The underlying technology combines several complementary neural network algorithms, which significantly increase the efficiency of the decision by minimizing missed events and false positives.
- The module facilitates with OSHA 1910.135 compliance.
- The module in conjunction with other ISS products can be used to create integrated solutions complementing the detection of helmets with facial recognition (SecurOS™ FaceX), access control system integration with single-factor or multi-factor authentication, people presence detection during restricted time periods, and more.
- Events from the SecurOS Helmet Detection module can be a data source for the system of automation of production control and behavioral security auditing processes — SecurOS™ Inspector.
- The module operates on the base of the SecurOS video management platform, which provides the ability to link video evidence to all the module alarms. Data from several control areas of the SecurOS Helmet Detection module can be processed centrally by a single operator (inspector).
- Integration with 3rd-party systems does not require significant resources due to the wide range of available SecurOS APIs.
- The system is hardware-agnostic: no specialized cameras are required.

OBJECTIVES

The SecurOS Helmet Detection module significantly improves the efficiency of the occupational safety system, which generally leads to increased enterprise economic efficiency, due to:

- Steady improvement in labor discipline and reduction in the number of industrial violations and accidents causing occupational injuries.
  The very fact that workers' behavior is monitored and recorded continuously has a preventive effect. Penalizing the violators, even if the violations did not lead to injury, will motivate other workers to follow the safety regulations. As a result, workers will become less likely to break the rules that are regarded as dangerous.
- Reduced costs (liability insurance) and the cost of the inspector staff.
  The module will take over all the responsibilities of detecting violations 24/7, and forming a violations database.

- Ability to investigate incidents.
  Achieved by the presence of an evidence base of violations.
- Prevention of downtime arising because of incidents.
  Achieved by reducing the volume of insurance claims, payments of sick leave to victims, court orders, and fines.
- Reduced reputational risks for the company.

APPLICATIONS

Manufacturing sites

Construction sites

Logistic complexes, multimodal terminals

Warehouses

TECHNOLOGY OVERVIEW

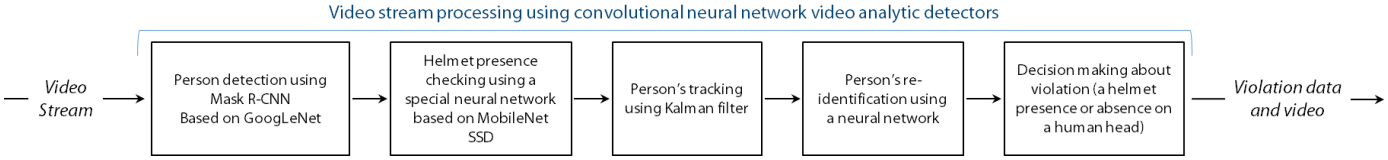
The algorithm for detecting people without protective helmets includes the person tracking module, the helmet detection module, and the alarm decision module in the event of the detection of a person without a helmet in a defined zone.

The input to the algorithm is a sequence of video frames. Using Mask R-CNN[1] based on GoogLeNet[2], people are detected on each frame. To determine the location of the helmet, the presence of the center of the helmet bounding box in the upper half of the human bounding box is checked.

Then the person bounding boxes from the detector are transferred to the tracker. The tracker allows to match people between frames in the video. It uses the Kalman filter[3] for the specific human track and the logic of matching people bounding boxes between the frames and predicting the position of new detections. The Kalman filter is based on a discrete dynamic system with a nearly constant rate. Moreover, a neural network that realizes the re-identification of a person is used to restore lost tracks.

A separate neural network based on SSD MobileNet[4] is used for detecting helmets.

The percentage of frames of people without a helmet, within a certain time period, is considered for each track. If the number of frames without a helmet appears above the alarm threshold, it is decided that the person detected with this track is “without a helmet”.



[1] *Mask R-CNN is a type of modern convolutional neural network for segmenting objects in images.*

[2] *GoogLeNet is an internal neural network used in Mask R-CNN.*

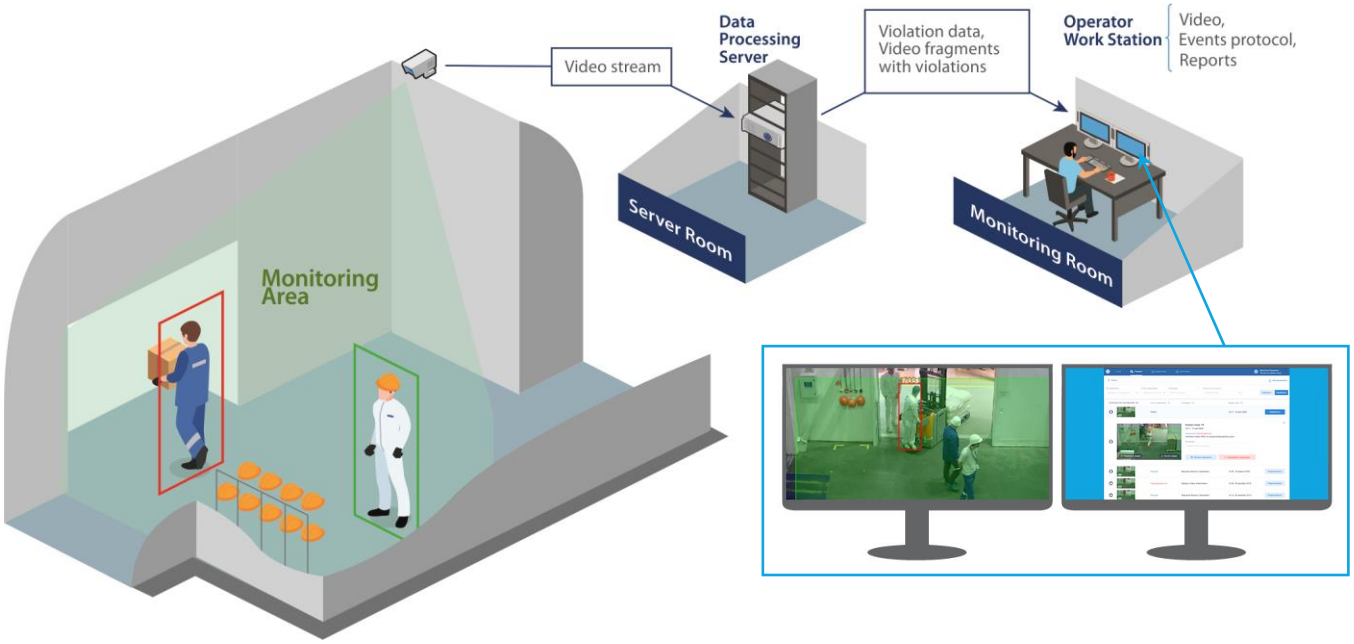
[3] *Kalman filtering is an effective recursive filter that evaluates the state vector of a dynamic system using a series of incomplete and noisy measurements.*

[4] *MobileNet is an effective convolutional neural network architecture, which reduces the amount of memory used for calculations while maintaining high predictive accuracy.*

REPORTING VIOLATIONS

Data on detected violations is available to the operator from the SecurOS User Interface (Media Client, Event Viewer, 2D/3D Map module), or can be received via system notifications (email, SMS, audio, pop-up window, etc…). Additionally, events are a source of data for the SecurOS module for labor protection and industrial safety (SecurOS Inspector) and can also be exported to 3rd-party systems such as EMS, ERP, etc.

BASIC HARDWARE AND SOFTWARE COMPONENTS



The module algorithms detect the presence of people without helmets in the video monitored area and form the necessary data set about the violation and the SecurOS operators will be informed about the violation by the preferred methods.

The SecurOS Helmet Detection module supports the ability to detect the violation immediately upon the detection of a person without a helmet on their head or after a fixed period of time to allow a person to put on the helmet. The helmet's color is irrelevant for the correct detector operation. It can be orange, white, blue, etc. The system will know if the helmet is not on a person's head but, for example, in his hand. In this case, the violation will also be detected.

TECHNICAL SPECIFICATIONS

ISS PLATFORM SUPPORT	
Supported Operating Systems	Windows 10 Pro; Windows Server 2012 R2, 2016, 2019 (64-bit)
SecurOS™ VMS version	SecurOS Premium 10.6 or higher; SecurOS Enterprise 10.6 or higher
CAMERA TECHNICAL DATA	
Varifocal or motorized lens	2.8 - 12 mm or higher
Camera view	Angle, Overhead, Horizontal
Minimal required resolution	FullHD (1920 x 1080)
Minimal required FPS	15 frames per second
Electronic shutter	Ability to work in manual mode: from 1/30000 sec to 2 sec
Camera angle	The angle of inclination relative to the horizontal plane is from 35 to 70 degrees
Camera mounting height	11.5 - 13 feet (3.5 - 4 meters)

ADDITIONAL TECHNICAL DATA	
Supported type of helmet/hardhat	All ANSI Z89.1 compliant helmets; All colors supported
Size of a person in frame	No less than 10% by height
Helmet size in pixels	Minimal: *50x40 pixels;* Recommended: *80x60 pixels*
Server GPU Requirements	NVIDIA GPU cards with supported CUDA Compute Capability (v.6.1 or higher)
Violation record data	• Type of violation; • Date and time of recording each violation; • Place of the violation; • Links to view and download a video clip of the violation

ORDERING INFO

PART #:	DESCRIPTION:
F-TK-HEL	SecurOS™ Helmet Detection (per camera)

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