



preventpcp

The state of the art of COTS (Commercial off-the-shelf) technologies



Day 2 – 19th January 2022
Open Market Consultation



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101020374



COTS aim

The aim of the performed research was to update the Commercial Off-The-Shelf (COTS) resulting of the PREVENT CSA project.

The **COTS update** was realized by the evaluation of the former COTS analysis considering the alternative products/technologies available on market.

The actualization was focused on four main technologies:

1. **Object classification and detection: capability to distinguish various objects (luggage, handbag, animal, person, etc.) and locate them in the image;**
2. **Association of an item to a person or a group: capability to associate an item to his / its owner(s);**
3. **Person re-identification and tracking:**
 - a) *Facial recognition (biometric data);*
 - b) *Body recognition (non-biometric data);*
4. **Unsupervised learning algorithms to detect unattended items.**

The updated COTS focuses on the four technologies mentioned above because they are the solutions most likely to meet the requirements of the PREVENT PCP challenge, namely the detection of unattended items and the tracking of the owner.



COTS methodology

1. Analysis of available products in public data bases (incl. Google; Scopus, etc.)

2. Verification of the product in terms of the date of application

3. Verification of the compliance with the former COTS analysis

4. Analysis of the product technical description in terms of possibility to adopt in area of the PREVENT PCP interest

5. Analysis of the product technical description in terms of compliance with identified gaps

6. Analysis of the product description in terms of the possibility of achieving the required usable properties and interoperability

1) Object classification and detection: capability to distinguish various objects

Object classification and detection is a **fundamental step in automatic video-surveillance** or video analytics. It allows **improved tracking** and a **more accurate description of events** allowing to distinguish between different objects in an image (human being, animal, luggage, vehicle, etc.). However, as real-world applications need a real-time, **flexible, easy and quick to configure solution**, the design of a practical object classification algorithm becomes a challenge.

Below are the example solutions available on the market (**24 solutions found in total**):

No.	Product name	Manufacturer	Graphic presentation of the technology or symbol	Description of the solution
1	Security Package	Cisco (US)	 	<p>Cisco® Video Analytics software offers users innovative ways to perform video analysis. The software provides an intuitive interface and powerful tools to enable organizations to make the best use of their surveillance video. Analytics processing occurs on capable edge devices, providing a cost-effective method of deploying video analytics on the network.</p> <p>Cisco Video Analytics offers a choice between two analytics packages: Security and Counting.</p> <p>The Security Base package provides tripwire detection, as well as the ability to classify objects, detect camera tampering and loitering events.</p> <ul style="list-style-type: none"> • Tripwire: Identifies user-defined objects that move in a specified direction as they cross over a line (tripwire) drawn within the camera's field of view. • Object classification: Differentiates between a person, vehicle, or other objects. • Camera tampering detection: Identifies any event that significantly changes the field of view of the camera. • Loitering: Detects when a person or vehicle remains in a user-defined area of interest for a configurable length of time. • Take away events: Detects when an object has been removed from a user-defined area of interest.



1) Object classification and detection: capability to distinguish various objects

No.	Product name	Manufacturer	Graphic presentation of the technology or symbol	Description of the solution
2	Classified Object Detection	Avigilon (Canada)	 	<p>Avigilon video analytics cameras and appliances are easy to install and can achieve positive analytics results without ongoing software adjustments. Avigilon's patented video analytics is designed to automatically adjust to the camera's field of view without configuration or adjustment.</p> <p>There are two modes of video analytics:</p> <ul style="list-style-type: none"> Classified Object mode detects and classifies objects such as a person or a vehicle. You can set up rules and alarms based on this detection in the Avigilon Control Center (ACC) software. This mode is used for Avigilon Appearance Search queries, Face Recognition, and Unusual Activity Detection which detects unusual speed and location of people or vehicles. Unusual Motion mode detects unusual pixel motion compared to the typical speed, direction, and location of movement that is typical for a scene. It displays anomalies so you can review recorded video that might not otherwise be seen.
3	AXIS Object Analytics	Axis Communications (Sweden)	 	<p>AXIS Object Analytics is an intelligent video analysis tool that detects and classifies humans and vehicles based on surveillance needs. It is useful for a variety of applications including public buildings, warehouses, parking lots, industrial sites and other unattended spaces in non-critical applications.</p> <p>Installed on compatible Axis cameras, AXIS Object Analytics provides intelligent surveillance. Video analytics algorithms suppress most sources of costly false alarms, such as vegetation, small moving objects, and rapidly moving shadows on the ground. This allows to focus only on the objects of interest and the real threats.</p>

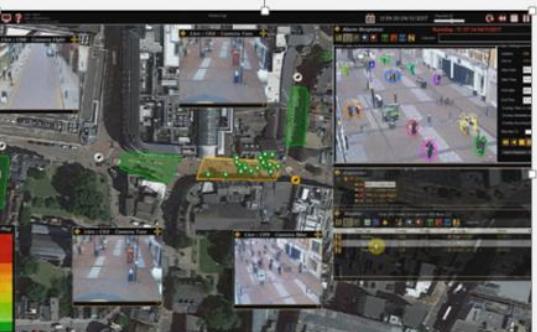


2) Association of an item to a person or a group

Association solutions will allow to **link an object**, such as a piece of luggage for example **with its owner or even in some cases its group of owners**.

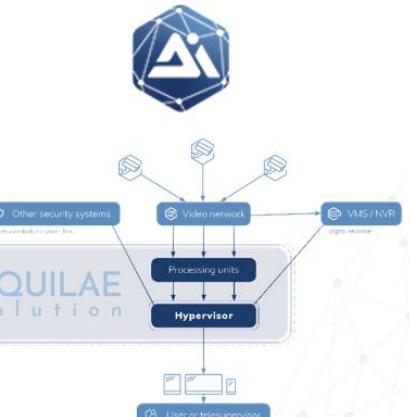
This technological unit is extremely important in the use case treated by PREVENT PCP, namely the detection of an unattended item baggage and the tracking of the owner. This association can, in some cases, be very complex with several subtleties (one owner, several owners, transfer of ownership of the object from one person to another, occlusion of the scene, etc.).

Example solutions (10 found in total):

No.	Product name	Manufacturer	Graphic presentation of the technology or symbol	Description of the solution
1	VI Suite AI	Atos (France)	 	<p>The core Video Analytics element of VI Suite AI is Ipsotek's patented Scenario-Based Rule Engine (SBRE), a tool to define behaviors of interest as they would unfold in the real-world dynamic and complex environment. It allows for multiple Video Analytics and AI events to contribute to an alarm trigger and leverages the ability to fuse inputs from multiple sensors to form a robust alarm. The SBRE can differentiate between complex scenarios such as a vehicle stopping opposite a sensitive building, driver leaving the vehicle and walking away, or a taxi stopping at the same location to let a passenger out. Another example would be differentiating between a passenger in an airport putting a bag on the floor and standing next to it from a person putting a bag down and actually abandoning it.</p> <p>Ipsotek works on the subject of association between an object and its owner using facial recognition and body recognition. However, the solution is not yet mature enough.</p>



2) Association of an item to a person or a group

No.	Product name	Manufacturer	Graphic presentation of the technology or symbol	Description of the solution
2	Aquilae (France)	Public buildings	 <pre> graph TD AI((AI)) --> VN[Video network] VN --> PU[Processing units] PU --> Hyp[Hypervisor] Hyp --> US[User or telesupervisor] OS[Other security systems] --> VN </pre>	<p>The AQUILAE system offers a decision support tool. By minimizing the number of false alarms, the system prevents loss of vigilance on the part of the operator due to too many visual and sound requests. To improve the functioning of the system permanently and independently, AQUILAE integrates neural networks into its algorithms, constituting real artificial intelligence.</p> <p>Through its Public buildings technology, Aquilae develops solutions around different use cases:</p> <ul style="list-style-type: none"> • Detect unattended luggage • Ensure public safety • Optimize flows <p>Aquilae works on the subject of association between an object and its owner using body recognition (non-biometric data). However, the solution is not yet mature enough.</p>
3	Foxstream (France)	FoxVigi		<p>The FoxVigi solution has a function to detect the appearance of an object in the field of view of the cameras. The "Static object detection" analysis is an application developed to detect the prolonged presence of one or more objects in a defined space. It is used to generate an alarm when an object appears or disappears in the scene. The detection time of this command can be configured. The object must have a minimum size and therefore be visible in order to be detected. The detection of objects and people is carried out using a specialized classifier derived from Artificial Intelligence and based on a deep neural network.</p> <p>The FoxVigi solution uses a combination of appearance and movement information to track and identify the actors (people, suitcases) present in the camera scene. Actor detection is done based on movement information. Shape and color information is extracted for each. This information can help identify the object from one image to another. The system also detects the separation of an object into two sub-parts. As a result of this separation, one of the two sub-objects (non-human) may remain stationary for a certain period (configurable). In this context, a pre-alarm is signaled. If the object remains static for a second period of time (also configurable), an abandoned baggage alarm is sent. In the replay tool, it is possible to view the instant of the pre-alarm and the alarm, with a clipping indicating the object detected as being abandoned.</p> <p>Foxstream works on the subject of association between an object and its owner using body recognition (non-biometric data). However, the solution is not yet mature enough.</p>

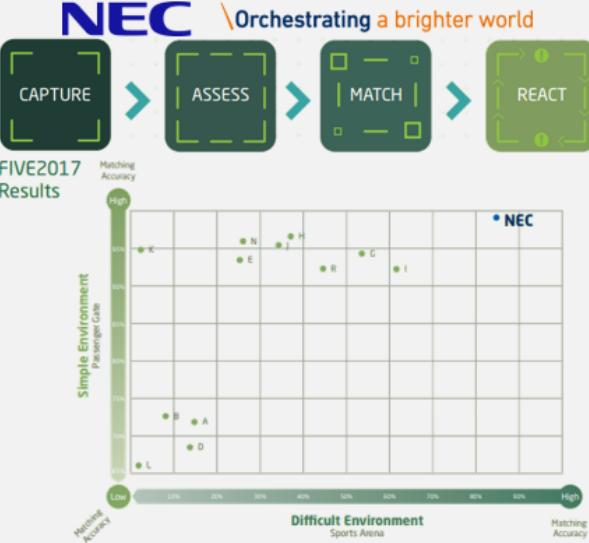


3) Person re-identification and tracking

Recent terrorist attacks have, in many cases, underscored **the ease with which individuals have been able to travel undetected**. In recent years, several of these attacks have taken place in train stations or on public transport. In this context, several tracking solutions using biometric data (face, posture, size, etc.) and non-biometric data (clothing, accessories, etc.) have been developed.

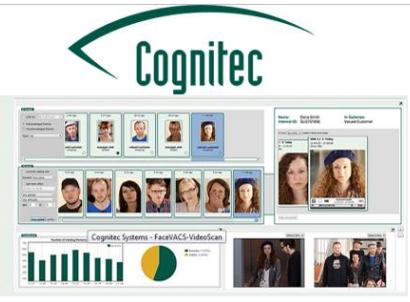
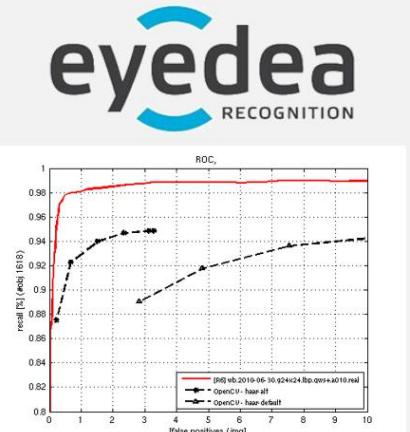
The goal is to **help video operators to quickly locate a person in time and space**. Indeed, the solution must be able to facilitate the search (deferred streams) or track in real time people of interest by relying on the use of biometric or non-biometric data. The challenges of such a solution are to improve the security of people and to limit traffic disruption.

a. Facial recognition (biometric data – 28 solutions found in total)

No.	Product name	Manufacturer	Graphic presentation of the technology or symbol	Description of the solution
1	NeoFace® Watch	NEC Corporation (Japan)	 <p>The graphic includes the NEC logo and slogan 'Orchestrating a brighter world'. It shows a four-step process: CAPTURE, ASSESS, MATCH, and REACT. Below this is a scatter plot titled 'FIVE2017 Results' comparing 'Simple Environment' and 'Difficult Environment' passenger gate rates against matching accuracy. The axes range from Low to High for both environment types and accuracy.</p>	<ul style="list-style-type: none"> Obtains facial images from video streams¹, still image storage² and third party integrated systems; Assesses individual frames of video and still images, detects faces and analyzes each face to determine its unique facial signature. Creates a small template for each unique face; Compares each template image against an enrolled image database until a match is found. Maintains a history of matches; Allows configuration of real-time alerts or messages to be sent to users or external integrated systems if there is a positive match against a database image. Offers a suite of post-event image comparison tools; Uses common hardware including IP cameras, servers and existing infrastructure. Smart device applications (iOS / Android) are also available; Integrates with other systems using web service APIs, offering an added dimension in facial recognition competency. <p>¹⁾ CCTV surveillance cameras, mobile video cameras or archived video footage ²⁾ Mobile cameras, smart devices and digital databases</p>



3) Person re-identification and tracking

2	FaceVACS	Cognitec (Germany)		FaceVACS Technology: <ul style="list-style-type: none"> • accurate portrait characteristics check for gender, age, pose deviation, exposure, glasses, eyes closed, uniform lighting detection, unnatural color, image and face geometry; • supports multiple algorithms to work. • advanced face recognition APIs: C++, Java, Microsoft .NET, BioAPI 2.0 Verification Engine (C API); • tools for biometric evaluations: e.g. generation of identification match lists, similarity matrix data; • compares faces against image galleries in real time; • displays real-time signals when user-defined events occur; • displays and exports statistics about people flow demographics and behavior; • sends signals and statistics to mobile devices; • supports interactive enrollment from still image and live video stream; • works with IP, GigEVision, and USB cameras, and Cognitec's own C5 camera.
3	Eye Identity	Eyedea Recognition (Czech Republic)	 <p>The graph shows an ROC curve with 'real' (red solid line) and 'OpenCV-haar default' (black dashed line) performance metrics. The x-axis is 'false positives / img' (0 to 10) and the y-axis is 'real [1] (prob[1 0])' (0.8 to 1.0). The legend indicates: (Red) 40_2019-06-10_924x24_Bp_2019x4010_real, (Black) OpenCV-haar default.</p>	Eyedea Recognition Eyedentity is a ready-to-use forensic software for face detection and recognition <ul style="list-style-type: none"> • Detection and recognition of faces in photos and video sequences; • Descriptor invariant to pose, illumination and facial expressions; • Similarity metric for fast recognition with millions of enrolled individuals; • Support of vast number of image and video formats; • Solution targeting all major platforms. <p>*629€ (cost The Expert license is used to process image databases. It detects faces, face landmarks, recognizes age, gender and positive emotion on single images and adds advanced functionality for a higher level of control over the processing).</p>
4	FRP	Thales Group (France)	 <p>gemalto a Thales company THALES Building a future we can all trust</p>	FRP is state of the art biometric face recognition solution. FRP can process videos in both live or replay to identify people in a non-intrusive way, without any operator intervention; <ul style="list-style-type: none"> • FRP can be easily integrated to third party solutions such as border and travel management, access control, ID check, security/video surveillance etc.; • Customers and partner can also easily build applications on top of FRP, thanks to its rich APIs (Application Programming Interface) for server based development as well as an SDK (Software Development Kit) for standalone application development; • FRP software can be run on multiple platforms (on premise, on a PC, in the cloud, on mobile or tablet, and different types of embedded environment). FRP Watch: <ul style="list-style-type: none"> • Processes hundreds of cameras in parallel; • Get alerts in less than a second.





3) Person re-identification and tracking

b. Body Recognition (non-biometric data – 6 solutions found in total)

No.	Product name	Manufacturer	Graphic presentation of the technology	Description of the solution
1	Face-Body-Object Recognition AI based platform	Oosto (Israel)	 The image shows the Oosto logo at the top, followed by a graphic titled "Better Tomorrow". The graphic includes the text "The world's most advanced Tactical Surveillance System, implementing deep learning algorithms to detect, track and recognize a Person of Interest in real-time." Below this are several icons: PERSON OF INTEREST, FORENSIC, MULTI SITES, OBJECT RECOGNITION, HUMAN RECOGNITION, and MULTI FACTOR INVARIANT. To the right is a screenshot of a software interface showing multiple video feeds and a list of detected objects.	<p>Using an existing infrastructure, AnyVision provides a set of advanced, automated tools that provide both immediate detection of events and video event analysis, turning each one into valuable data.</p> <p>The technology is based on a self-learning, AI-based person-and object-recognition software. A plug and play solution for new and existing systems that overcomes challenges such as occlusions, different angles of view, and poor light conditions. Among other things, it can be used to find and identify missing or wanted objects or persons in large crowds, to support the work of authorities such as the police, and to optimize processes.</p> <ul style="list-style-type: none">• Face Recognition• Body Detection using non-biometric data• Object Identification• On-boarding and Authentication platform for financial institutions
2	INTERIOR MONITORING SYSTEMS	NVISO (Belgium)	 The image shows the NVISO logo at the top, followed by a screenshot of a car's interior dashboard. The dashboard displays a heads-up display (HUD) with the text "12 mt" and "TRAFFIC JAM AHEAD". Below the HUD, there is a small screen showing a camera feed of the road ahead.	Artificial intelligence (AI) systems used in intelligent mobility. The system can find and classify a variable number of objects in an image or video sequence, such as faces, pedestrians, or other unprotected road users.



4) Unsupervised learning algorithms to detect unattended items

99% of surveillance video being generated and recorded **is never watched** by anyone and produces no value whatsoever. This is because there is simply too much data to humanly process. This results in **missed detections of abnormal events** that could be happening in scene. Current methods have tried to automate this by using rule-based approaches in video analytics (See 1) Object classification and detection). Other technologies uses an unsupervised Machine Learning technique that is able to analyse vast amounts of surveillance video autonomously which does not require users to pre-define the rules for event detection. It is able to automatically identify patterns (i.e. motion, trajectories) in a scene and find deviations and abnormalities to warn of potential security and safety threats.

Conclusion from current SOTA analysis and researches: current technology **isn't able** to provide a detect anomalies system in real time **without requiring** normal or labelled logs, **thus, a system dedicated to anomaly detection frameworks should be develop:**

"Log files record precious information, they show up as a valuable resource for debugging and preventing failures. However, log file sizes have grown too large for humans to perform timely and efficient analysis. To solve this issue, many researchers have proposed automated anomaly detection frameworks. However, the current state-of-the art fails at providing an anomaly detection framework which can detect anomalies in real time without requiring normal or labelled logs".

Zeufack V., Kim D., Seo D., et al., *An unsupervised anomaly detection framework for detecting anomalies in real time through network system's log files analysis*, High-Confidence Computing, 1, 2021





4) Unsupervised learning algorithms to detect unattended items

Example solutions (4 found):

No.	Product name	Manufacturer	Graphic presentation of the technology	Description of the solution
1	innovi Enterprise	AGENT VI (Israel)	<p>Rule-based Detection Perimeter Protection</p> <p>Anomaly Detection</p> <p>Unusual (anomalous) event</p>	<p>Deep Learning-Driven Video Analytics for Comprehensive Coverage. innovi Enterprise is an innovative video analytics software designed to meet the security and safety needs of multiple vertical sectors. Combining Agent VI's vast field-proven experience with deployments of all sizes and highly advanced, cutting-edge Deep Learning technology, innovi Enterprise helps surveillance operators to uncover otherwise hidden events, insights and information. innovi Enterprise enables leveraging of the surveillance infrastructure for security applications and beyond and is available as an Agent VI Hosted service or Customer Hosted (on-premise) solution.</p> <p>innovi Enterprise eliminates the need for continuous human monitoring of surveillance cameras. It automatically detects and alerts to security and safety incidents in real-time, thereby drawing a surveillance operator's immediate attention to an incident. innovi provides situational awareness to effectively manage incidents and enable effective responses, as incidents unfold.</p>
2	RICOH Abnormalities detection (R&D Field)	RICOH (Japan)	<p>Detecting areas of difference from the normalcy (red frame)</p> <p>Normal behavior Abnormal behavior</p> <p>Detecting unusual behaviors (lying on the stomach or falling, for instance)</p>	<p>To allow AI to learn about anomaly detection, you need to identify and provide all abnormal states that should be detected. Yet most of the videos recorded on surveillance cameras are of normalcy. Beyond that, it is unrealistic to predict every single anomaly in the first place.</p> <p>Thus, Ricoh has come up with the idea of using semi-supervised anomaly detection, a technology proven in appearance inspection and frozen road detection. Anomalies can now be detected even when very little anomaly data is available.</p> <p>The technique uses only the videos of normalcy for learning. All scenes that depart from normalcy (for instance, an increase or decrease in things, or unusual behaviors) are determined as anomalies. This scheme allows the detection of unknown, different anomalies.</p>



COTS conclusions

1. A broad update of COTS analysis in the range of new or upgraded products available on the market in the field of three key technologies has identified new areas of product development in the above-mentioned scope. It indicates new products, new modernizations and, possibly in individual cases, the end of product development.

2. The idea of introducing the possibility of combining various technologies should be take into consideration due to the overwhelming majority of available systems which only satisfy a certain part of the identified needs (e.g. only tracking a given person or only recognizing a person / object). It is a natural phenomenon of specialization for which it would be optimal to combine existing advanced solutions into one. Such a solution would guarantee a much higher quality than current systems which, due to limited capabilities, have to choose between the quality of the solution and the expansion of usability.





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Thank you for your attention!



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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101020374

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