Detection of Dangerous Goods

Principles and technologies

January 2008

SURVISION - SAS au capital de 571 440 Euros

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1. Introduction: issues of detection of dangerous goods

It is recognised that the mere presence, in high-risk areas, of vehicles transporting dangerous material may transform banal traffic incidents into catastrophic events often with a high human and material cost.

These high-risk areas may have one or several of the following characteristics:

- Confined conditions which make the consequences of accidents which may occur even more devastating (tunnels, town centres).
- Situations of restricted access which make the evacuation of users and the access to aid much more difficult than on traditional routes (tunnels, bridges).
- Locations close to high-risk installations or storage areas of toxic products (nuclear sites, Seveso sites etc…).

Recent accidents have demonstrated that the presence of lorries in general and especially of lorries transporting dangerous goods was likely to provoke damage out of proportion with the initial incident.

Up to now, the detection, follow-up and control of lorries transporting dangerous goods has been based entirely on visual checks usually carried out by representatives of the forces of law and order or by the companies of the sites in question.

These checks are in general neither systematic nor efficient, because of the amount of traffic flow to be managed at certain sites. In any case, the cost of rendering these checks efficient would be prohibitive if they were to be carried out exclusively by human means, without the assistance of identification assistance tools.

However, despite their limitations, the checks, have shown that any regulation access restrictions which may exist are frequently not respected by the transporters, whose priority it is, is to find the shortest journey between loading and unloading points.

For all the above reasons, the implementation of automated control systems, and possibly of sanctions for the access to regulatory sites involves major issues for public security and for road infrastructure cost-efficiency.

The only method which can be envisaged at present depends on the detection and recognition of dangerous goods signs which transporters are obliged to attach to their lorry. This identification is necessarily based on sophisticated optical techniques.

2. Regulatory background

The signing concerning the transport of dangerous goods has been unified since 1997.

Dangerous goods being transported should be presented with various different signs including signs with hazard codes and hazard symbols.

These signs should be visible at the front, at the rear and on each side of the container. They are orange and measure 30×40 cm. They are divided into two parts widthways. They contain identification numbers (see below), or can be empty if the container used may transports several dangerous goods.

The hazard code is in the upper part. It is composed of two or three numbers, sometimes preceded by a letter, which indicates the nature of the hazard in question. The first letter represents the main danger, and there is always a second figure representing the secondary danger (0 if there is only one danger). If necessary, an additional hazard will be represented by a third figure.

The presence of the letter X in front of the numbers indicates the hazard of a violent reaction if the product comes in contact with water.

For more information on the regulated signing of the transport of dangerous goods, see the texts of the EU or the summaries published by the different organisms concerned.

For example:
http://en.wikipedia.org/wiki/Dangerous_goods

3. Restrictions and limits of detection of dangerous goods

The dangerous goods signs have the advantage of being perfectly standardised in Europe and in most countries of the world.

The diamond sign contains a lot less information than the identification rectangle. This is therefore the element which has to be identified and read.

The identification rectangle should be attached:

- On the front of the vehicle.
- On the rear of the vehicle.
- On the side of the vehicle when the load is composed of several distinctive trailers transporting different materials (in this case, unmarked orange rectangles are stuck on the front and on the rear, which implicitly indicate consultation of the side rectangles).

Reading from the side is not usually possible because of the concealing effects caused by the presence of several parallel lanes.

Reading from the rear of trailers presents several disadvantages which limit the inefficiency (presence of several non-essential pieces of information).

It is preferable to carry out the identification on the front of the vehicle.

One of the difficulties consists in identifying in a specific way the dangerous goods sign and the number plate which have similar signs. Any confusion between these two signs would make the identification of one of the plates impossible. Also, in most cases, it is necessary to distinguish them, because both the dangerous goods and the lorry need to be identified (using

its matriculation number) in order to ensure a relevant follow-up. It is only useful to know that a given transporting dangerous goods has entered a tunnel if we can also tell that this same lorry – identified in a unique way by its matriculation – has left the tunnel or not.

Other issues which represent restrictions in relation to the state of plates for dangerous goods:

- Some plates are in fact stickers, which are less reflective to infrared.
- Some plates are so damaged or so dirty that they are almost impossible to identify and read.
- Some plates are made up of individual numbers grouped in a way that limits the readability.
- Some plates are not regulated (non-conform characters, non-reflective support etc…)

All of these restrictions limit the efficiency of the identification and the reading of plates for dangerous goods. Survision estimates that the goods can be identified and read correctly in 90% of cases at the most.

Although limited, the efficiency of the control by optical technologies is still more precise than a visual control and its systematic nature make it a major instrument in the reinforcement of security in tunnels, on brides and in town centres in Europe.

4. The solution proposed by SURVISION

4.1. Functional principles and architecture

SURVISION has made great efforts to perfect a solution combining specifically designed cameras and sophisticated algorhythmic techniques of image-processing, in order to allow for the deployment of efficient tools for the control of the flow of vehicles transporting dangerous goods.

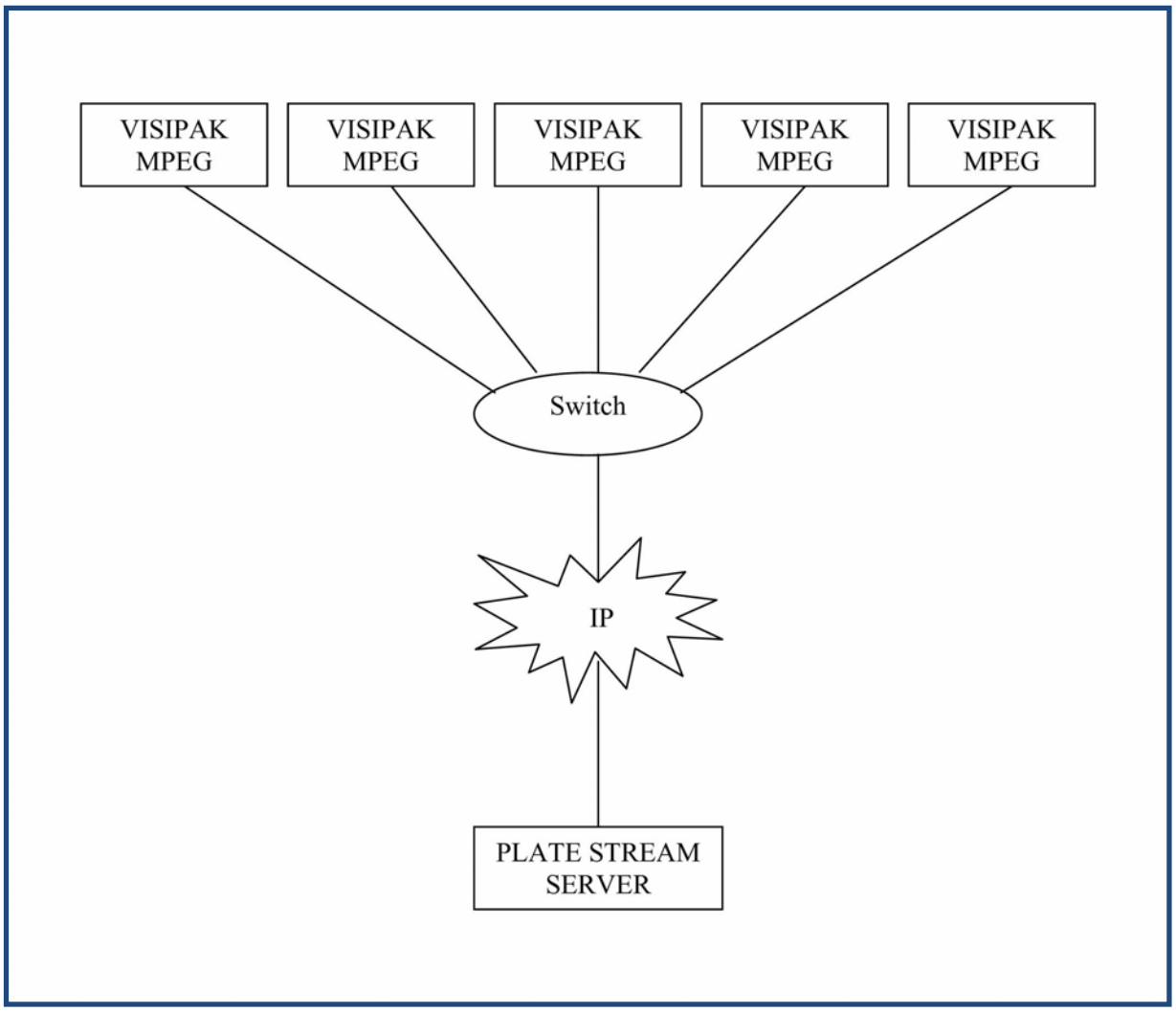
The proposed architecture is based on a set of cameras deployed along the site that is to be protected.

A camera should be located at least at the entry and the exit of the site. In some cases (tunnels or particularly long bridges), cameras can be made available at regular intervals in order to benefit from a more accurate identification of vehicles transporting dangerous goods.

A camera should be planned for each traffic lane. Consequently, if there are several parallel lanes (which is the usual case), a control point should have several cameras. This is the only way to ensure good plate reading performances.

These cameras provide digital video streams which are infrared and optimised for remote servers called PLATE STREAM SERVER. The transmission is carried out using a standard IP network.

The remote servers extract in real time and at 50 images per second (in order to guarantee a better performance on vehicles travelling at high speed) of both dangerous goods and matriculation data.

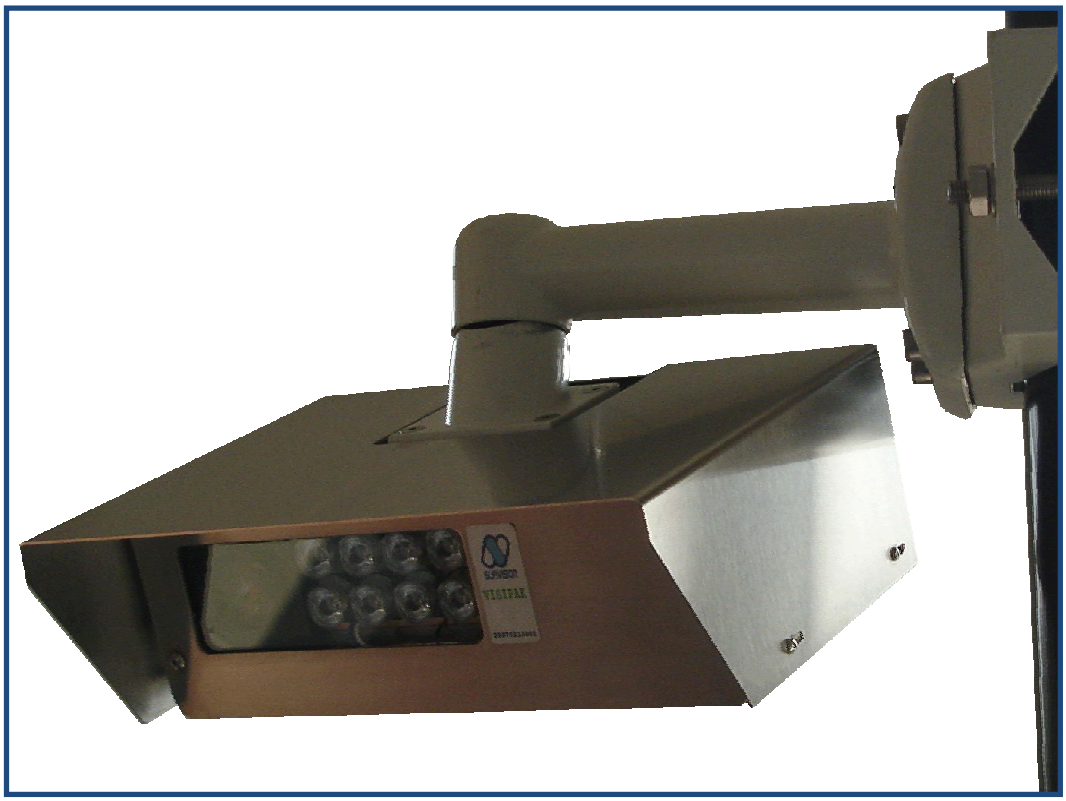


This data is made available in real time on the network and can be integrated using a SURVISION middleware.

4.2. Equipment specifications

4.2.1. Cameras

The cameras used for the detection of dangerous goods are the SURVISION VISIPAK MPEGs.



In these cameras, all of the necessary elements for filming are embedded in a single casing:

- SONY optical unit.
- LED of infrared illumination which works in an invisible range (850 nanometers).
- Electronic synchronisation components between the shutter of the camera and the LED illumination.
- Electronic processing components which allow for the digitalisation and MPEG4 compression of the stream at the source in order to facilitate transport and storage.

A bi-camera version exists (VISIPAK MPEG-OV) which allows us to obtain, as well as the stream which will be processed in order to extract the plates, a high-quality contextual colour stream.

The VISIPAK MPEG is specifically designed for tunnels:

- Exclusive use of very high-quality raw stainless steel.
- All fixation elements are blocked and the chain is to avoid camera falling on traffic lanes.
- IP67 protection which allows for high-pressure cleaning.
- Upper fixation to allow for positioning over an arch.
- Waterproof connectors and remote adjustment devices in order to reduce time required for on-site interventions.

These cameras provide very high quality video streams optimised for recognition of dangerous goods signs and matriculation numbers. The streams are optimised because:

- They are infrared within the wavelength of reflectivity of dangerous goods signs and matriculation plates.
- A dynamic control of the camera and LED parameters allows us to constantly obtain the best possible image of the plates.
- The compression algorhythms allow for best conservation of the contrast of characters written on the plates.

For more information on VISIPAK MPEG and VISIPAK MPEG OV, see the camera presentation datasheets and the documents presenting the detailed specifications of these cameras.

4.2.2. Treatment units

The treatment units are servers which run on Windows. They do not have any special features except that they have a processing power sufficient to carry out the extraction of number plates and dangerous goods signs at a frequency of 50 hertz.

SURVISION can supply on demand the detailed specifications of these processing units depending on the number of flows which can be treated by one unit.

4.3. Software specifications

The recognition of plates for dangerous goods uses technologies similar to those used for the number plate recognition, an area in which SURVISION is recognised as one of the main specialists.

For more details on the techniques used by SURVISION for number plate recognition, see the presentation document of the specifications of the SURVISION software.

Certain specific elements should however be taken into account and require adaptation of the algorhytms of image processing or the addition of specific alorhytms. These are:

- The rectangular format and the presentation on two lines of information requiring a particular processing.
- The frequent lack of reflectivity of the plates requiring a processing of characters with weak contrast.
- The co-existence in the same image of signals coming from the sign dangerous goods and the matriculation plate which require the dissociation of these signals in order to allow a distinct processing.

4.4. Data integration

SURVISION offers a simple and user-friendly middleware which allows the integrators to construct interfaces and databases which integrate the data produced by the SURVISION cameras and servers (dangerous goods codes, matriculation numbers, JPEG images and real-time video streams).

For more information on this middleware, see the SDK documentation (Software Development Kit) accompanying this middleware.

SURVISION offers trainings to the integrators which wish to familiarise themselves with this middleware.