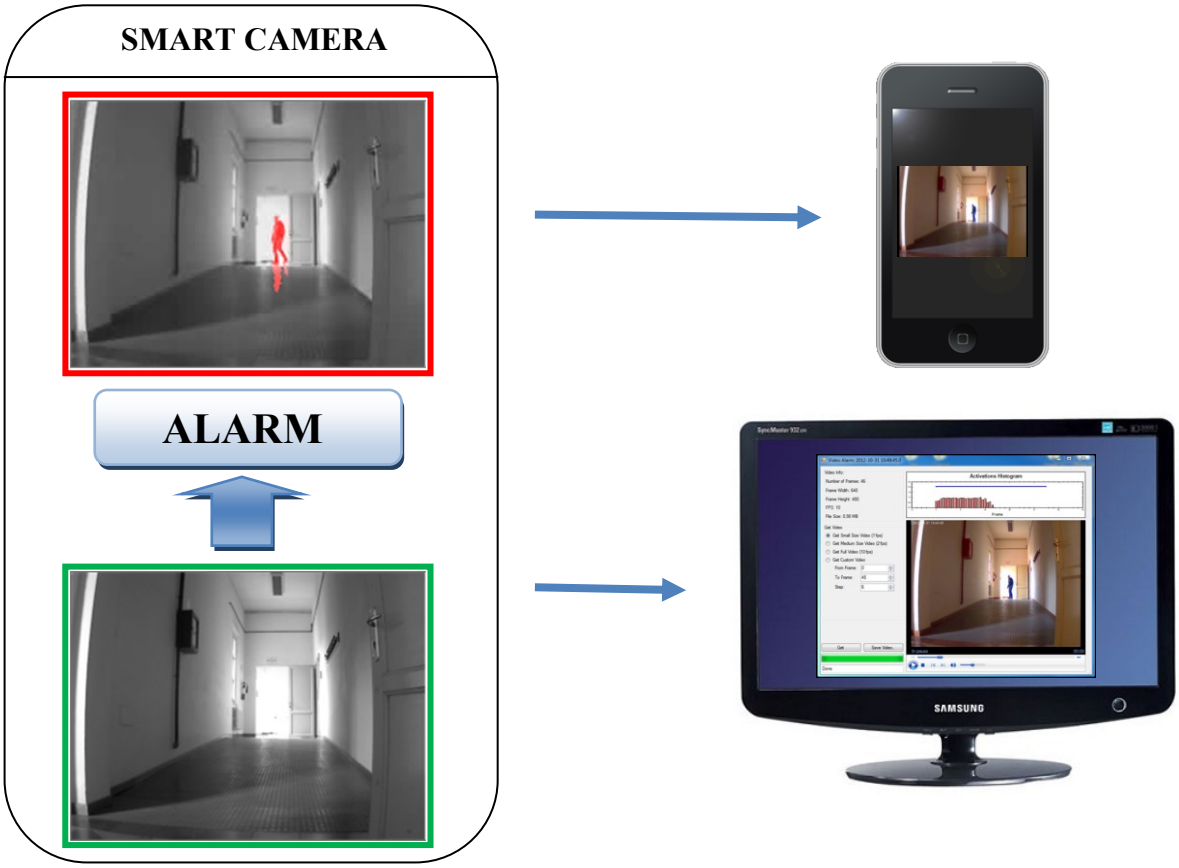
Project:	Document:
Smart Camera	Intelligent Urban Surveillance

1. Project Overview

This project consists in the design, implementation and deployment of innovative Smart Camera based intelligent systems for urban surveillance. Surveillance of sensitive areas in real-time is one of the primary measures to ensure early detection and response in the event of any incident, from minor disturbance to serious criminal activity. The visual deterrent of cameras can itself be a useful tool for crime prevention.

A traditional computer vision system acquires images from a camera and performs processing and recognition on an external device (e.g. a video server). This approach has several limitations: i) high hardware costs; ii) the system is bulky; iii) the data transfer between the camera and the computer is very high; and iv) the image acquisition and transfer in public areas has repeatedly elicited questions about privacy.

Smart Cameras are low-cost and small-size devices embedded with both the acquisition system and the processing system (CPU, memory, storage,..). With Smart Cameras is possible the development of distributed vision systems where several sensors, connected through an IP network, are able to solve hard tasks: video surveillance, traffic control, quality control, automatic localization of vehicles or goods.



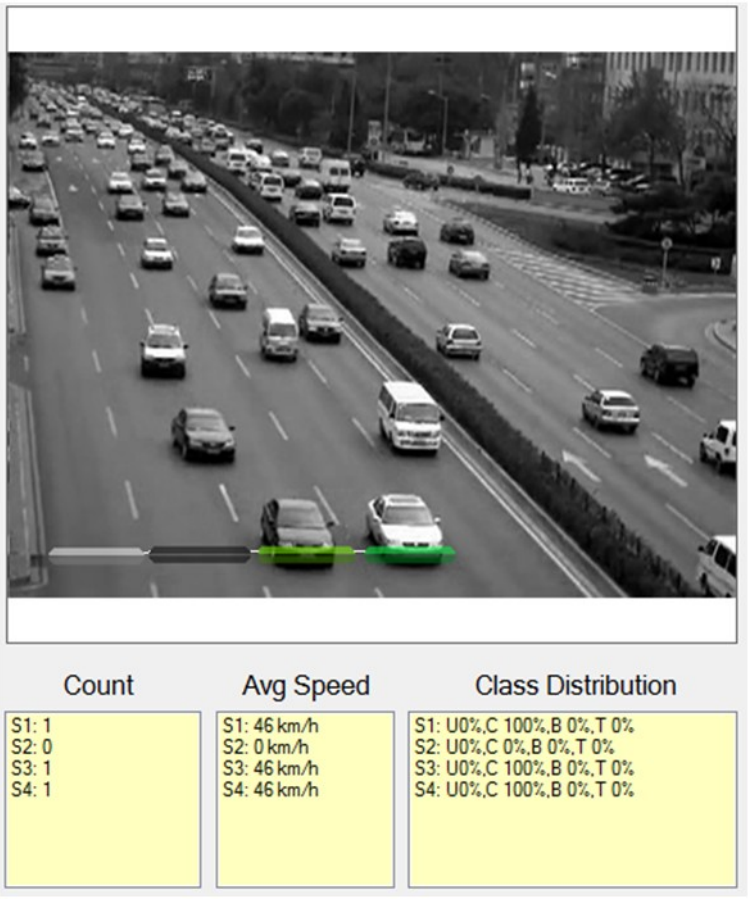
2. Target Applications

Smart Cameras can be exploited for a number of target applications; some examples are given in the following sections.

2.1.1. Traffic Technologies

To meet the increasing demand for real-time traffic and infrastructure information, this project facilitates the sharing of high-quality live video from highways, intersections, tunnels, bridges and main commuter routes. The wide range of benefits includes:

- quick redirection of traffic to avoid congestion;
- accurate information in real-time for first responders to speed their arrival and incident preparation;
- better analysis of traffic type (cars, trucks, bikes, ...);
- public information outlets can convey detailed traffic information to their viewers and listeners;
- municipalities can give commuters access to live video over the internet to help them make smart travelling decisions;
- road and other related maintenance can be optimized based on current conditions;
- city planners can integrate metering equipment with stored video to plan road improvements.



2.1.2. Security and Surveillance

The demand for reliable surveillance systems is increasing, especially for mass transit and public areas such as airports, railway and subway stations, sport and concert event venues. For this reason, video surveillance systems that, through the analysis of video sequences, perform automatic detection of security-related events or aid human personnel at monitoring a place are gaining increasing interest. A key aspect for current video surveillance systems is the capability of reliably detecting common events such as abandoned and removed object within the scene or the automatic detection of intrusions in private areas.

Smart Camera-based solutions allow to develop embedded and not intrusive architectures able to be long-term operating, to execute surveillance algorithms completely locally and to rise alarms only when suspicious events happen.

2.1.2.a. Abandoned/Removed Objects

An effective and efficient detection of abandoned objects is very important to prevent attacks on landmarks, public transportation and critical assets. The automatic detection of stolen objects is critical for crowded environments like museums.

We have developed a framework to robustly and efficiently detect abandoned and removed objects in complex environments for real-time video surveillance.

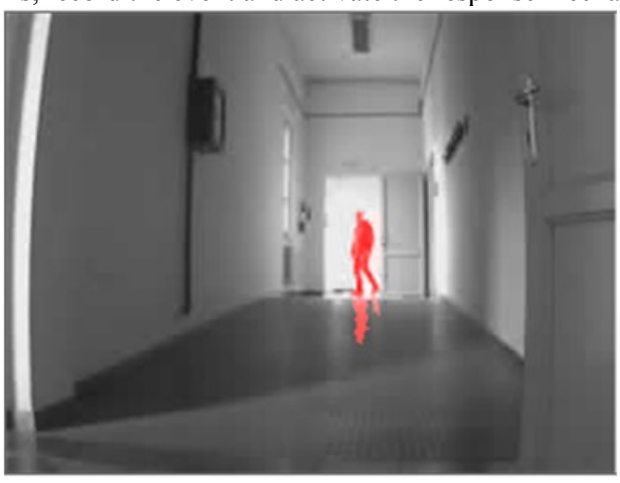
The intelligence in the camera is able to provide a continuous state of high alert and, over interest regions, record the event and activate the response mechanism so that the appropriate action can be taken.

The system can be applied in several scenarios such as

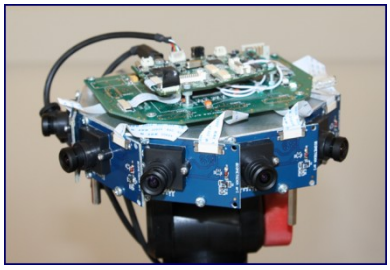
- detection of unattended packages in a railway station or in an airport;
- detection of stolen objects in a museum;
- detection of parked vehicles;
- detection of left-luggage.

2.1.2.b. Intrusion Detection

High-sensitivity low-cost Smart Cameras can be used to detect intruders, unusual behavior, fire or any type of environmental abnormality. They are able to provide outdoor surveillance even under faint lighting conditions. The intelligence in the camera is able to provide a continuous state of high alert and over interest regions, record the event and activate the response mechanism so that the appropriate action can be taken.



2.1.2.c. Panoramic Control



The aim of this project is the development of a compact and cheap digital multicamera where multiple sensing elements acquire partially overlapped views and a real-time stitching transform them into a single geometrically rectified image.

The advantages over standard IP cameras are:

- Real 180° without mechanical pan/tilt (extendible to 360°)
  - motorized systems can introduce vibrations and generally have a shorter life time;
  - simultaneous sensing of the entire viewing area (no delays due to the mechanical position adjustment).
- No oversampling
  - some systems uses a single sensor and a fish-eye lens or a special mirror for 180° or 360° view. However, the resulting image is typically very distorted and usually cannot be satisfactorily rectified without excessive oversampling.
- Extraction of 3D information
  - the use of stereo-vision techniques allow to extract 3D information and to estimate the distance of the objects from the multicamera.