

A Healthier City

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Naples is to host a new project attempting to reduce both environmental and acoustic pollution

Because of difficulties humans seem to have in managing urban areas and all their associated activities, the pollution generated by city life often exceeds permissible thresholds.

The rejuvenation of city air quality is possible only if there is continuity between the scientific instruments and the decision-making structure. It is necessary for an approach to investigations to obtain the best operational solutions to all situations. The management of pollution caused by traffic has a primary role in this context, and the possibility to minimize it depends on the capability to manage the traffic in several aspects.

The objective of maximizing the air quality with a management and control system is to solve the problem at its source, with the identification and neutralization of the causes. To achieve this objective, monitoring is a useful activity to specify the actual causes; analyse the components; compile key information; and handle results with the aim of making a decision support system capable of managing the situation.

Air, noise and traffic

This project stems from the need to consider the whole urban environmental degradation problem with an innovative methodology. The starting point is the restating of the urban functionalities, as a part of a reorganization process of these activities and the environmental components existing in the city.

The system in Naples manages vehicles in a test area, depending on the pollution measures and the medium- and short-term pollution forecasts.

The plan is to be able to automatically support decisions in emergency situations as well as in normal conditions, be they situations that cause environmental or acoustic pollution.

Sections and main objectives

The program has been divided into four sections.

Section 1

Development of a real-time information system to:

- Acquire and validate data;
- Determine the state of the air quality in the monitoring area;
- Create simulation models to forecast the evolution of environmental pollution;
- Use expert system techniques to activate the immediate and long-term corrective actions for the traffic or other polluting sources.

Section 2

This section concerns the development of an automatic program that identifies the pollutants associated with every pollution source present in the area. This will be done with; probabilistic correspondence models integrated with descriptive databases; traffic data management; and meteorological data management.

Section 3

This covers the development of an automatic system to evaluate the acoustic pollution in the area.

The appropriate tools will reveal all the necessary information for the evaluation of the noise distribution and levels, and for the characterization of the several noise sources.

Section 4

Finally, running the whole system and field validation, with testing of many situations. The system will be integrated with other systems and a functional verification of the planned solutions.

Objectives and expected results

The main objective is to make a decision support system for emergency situations as well as for the ordinary situations of urban management. This will be possible through:

- Continuous real-time data collecting with the integrated utilization of different kinds of sensor;
- Connection of the sensors with a high speed communications network;
- Networking of the sensors, and communications centres existing on the territory;
- Real-time data management of the huge amount of data collected from the sensors through the communications network;
- Continuous elaboration of medium- and long-term forecasts.

Project area

For this kind of project, it's important to choose a diversified area, including several kinds of urban zones: residential, commercial, tourist, etc, that will be representative of the whole city and will include a range of different pollution situations.

In the example project, an area in the city of Naples with an area of 4km² has been chosen, consisting of several sub-zones with different structures and uses. The use of sub-zones determines the kind of trips the vehicles make between sub-zones or inside the same sub-zone.

Air quality

The diversity of the air quality conditions and causes of pollution inside the selected area is an important point to ensure the methodology applied and the results obtained in this scenario are applicable to another areas. There are several pollution monitoring stations placed in the area showing different values and different dispersion behaviour for the pollutants monitored (CO, NO₂, SO₂ and particulate matter).

It is also necessary to consider the different meteorological conditions of the monitoring stations, in particular the winds, and also the presence of green zones, like parks and a botanical garden, important for the measurement of ozone.

Acoustic pollution

The selected area is also interesting from the acoustic pollution point of view for several reasons.

First of all its situation, centered in the city, with a high level of traffic and economic, industrial, and residential human activity. The main city north-south and east-west streets run through the area.

There are two important sources of noise, one caused by vehicles, and the other caused by human activity in the area. It has been verified that there is not much difference between the normal situations (with traffic and human

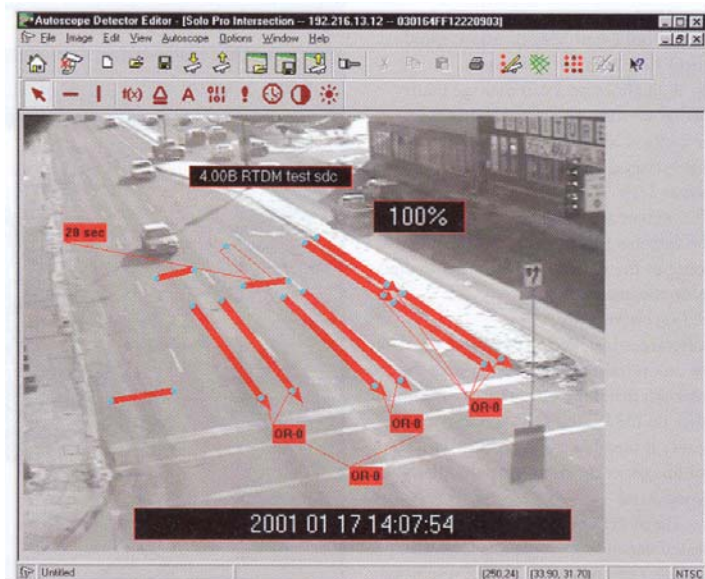


Figure 1: Setting up virtual loops

activity) and the situation when traffic is congested, so it is possible to consider both sources as equivalent.

For the noise propagation there are also two cases of interest, both included in the selected area. The first case is the propagation of noise in the areas of high buildings and narrow streets, where interesting phenomenons such as absorption, reflection and diffraction of the sound are considered. The other case is the open field propagation, where there is no reflection or absorption and atmospheric conditions like wind direction and speed tend to limit the noise propagation.

Traffic types

To study the composition of the traffic, vehicles have been broken down into groups: cars, motorbikes, commercial vehicles, buses and the total amount of vehicles.

Flow measurements have been made based on several sets of data: Historical data with an average flow of vehicles per day, measured on different points of the area in study; average flow of vehicles per day measured at the roundabout; and flow of vehicles measured by the inductive wire loops an the machine vision cameras near the centralized traffic lights.

From the analysis of this data, it is possible to determine the traffic flow evolution during the day, the peak hours and the congested zones.

Real-time data collecting

To collect traffic data real-time, Self-Sime has developed an innovative application that allows the user to collect not only traffic data, but also traffic alarms and real-time video images.

Therefore it's possible to save and analyse traffic data (number of vehicles, classification, average speed, etc) and to follow the time evolution of this data real-time, and point the attention automatically to an image where there is a traffic problem or an incident without having to watch all the images from all the cameras continuously.

The system

Cameras

The cameras are Solo Pro, colour, with zoom. The video processing is made inside the camera, therefore the camera makes the video information available as well as the traffic data.

Otherwise, the machine vision processor can be external to the camera, with the same features as the integrated system.

Virtual loops

The traditional inductive detector loops buried in the pavement are substituted with 'virtual loops', which are drawn directly over the image, and are part of the camera programming, to retrieve data about count, classification, speed, queue detection, incidents, etc.

A single camera can manage many virtual sensors. The virtual sensors can be configured modified easily, making this system useful and versatile.

Server Web

This makes available the images given by the cameras for Internet transmission. It contains the Frame Grabber used to digitalise the images.

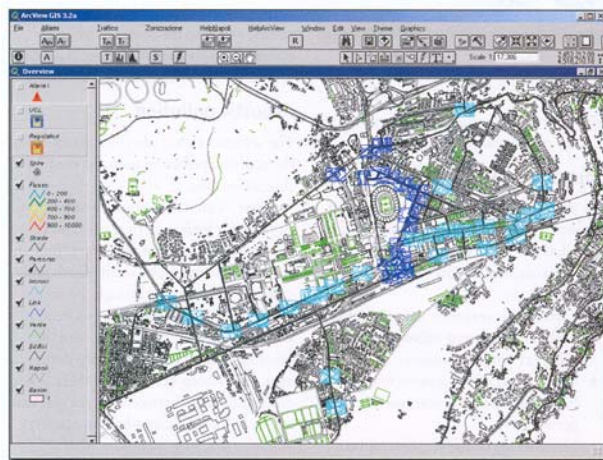


Figure 2: Zoom area facility

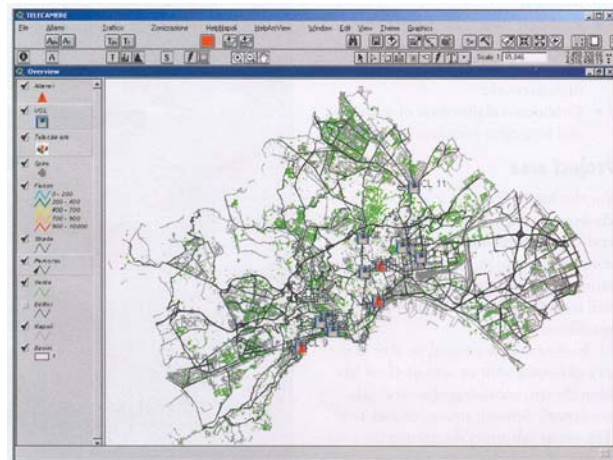


Figure 3: General city overview

or

Video compression

Software is installed to compress the data for an optimized transmission over the Internet. Installing de-compression software on the PC used to view the images makes it possible to watch clear and fluent images even without a particularly broad band.

The system is automatically calibrated depending on the available transmission rate to supply the best resolution and image fluidity.

Real-time video and data

Internet connection

The data and image transmission can be made with fibre optics or, where this is not available with DSL connections, which are digital and offer a suitable transmission rate with low cost.

User software interface

The interface provides in a simple and intuitive way the data from a large number of cameras and makes reading the data easier. The cameras are catalogued in a tree format and described with the street name or a user-defined parameter. The selection is easily made with the mouse, and the data is available in a numerical or graphical format to simplify reading. It is also possible to select one image and to watch the camera real-time.

Cartography

The user interface software in this project is cartographic. Having a map of the place it is possible to make a digital map indicating the position of each camera.

Therefore, it is possible to evaluate the situation looking directly at the map, and the references colour that change with the situation of the queues, incidents, and bad-functioning, etc.

To get the video images and the traffic data from one of the cameras situated on the monitoring area is as simple as selecting it on screen with the mouse.

Centralisation

The system integrated by the cameras and the software can be integrated with the traffic lights control systems for an efficient centralized management.

For this application, Self-Sime has also developed a system for data acquisition joining different detector technologies: wire loops, Autoscope 2004 and Autoscope Solo, that integrates the data read by the detection systems and manages all the information real-time, as described above.

Mobility analysis and traffic simulation models

The mobility simulation in the area of interest is on the base of the system. To have an image of the present environmental acoustic traffic situation it is necessary to be able to forecast with precision the vehicle flow in the whole network.

The methodology used in this project integrates the real-time monitored data from the sections of interest with the results of the traffic simulation made with an analytical model calibrated for the monitored area.

In more detail, the system, installed in the operation centre and connected to the machine vision traffic sensors, will be able to select, in reference to some marco-parameters like date, time and meteorological conditions, the traffic scenario most similar to the actual situation; and then can re-calibrate the main inputs (the origin/work), and proceed to calculate the traffic parameters of the network, the pollutants and noise emissions, and finally diffusion.

Improving the simulation

Traffic monitoring is an important tool to improve traffic simulation modeling in several aspects, like:

- Changes on the traffic balance that affect the monitored area;

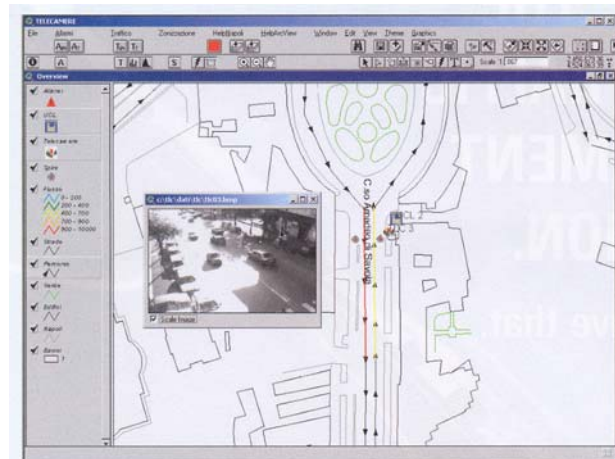


Figure 4: GIS detailed overview with on screen traffic data

- Better calculation of the OD matrices and the network section features (capacity and speed);
- Changes of vehicle numbers in the area.

A Decision Support System (DSS) has been planned which, with the base of some typical situations, the traffic models and the pollutants propagation simulations, makes continuous monitoring of:

- Mobility;
- Air pollution;
- Acoustic pollution;

Also, the DSS will foresee the calculation of the new environmental situation regarding the application of interventions as well as the comparison between the obtained results from pre-defined decisional group. Finally, it will suggest some intervention strategies from the environmental efficiency.



Dati di traffico per la stazione N° 124

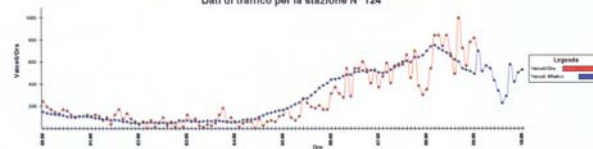


Figure 5: Real time data and video through the Internet

These strategies are divided into two categories:

Local interventions

Comprising those applied at the place where the emergency situation is created, like a re-direction of traffic flows, modification of the waiting times, or a modification of junction layout.

General interventions

Including those applied in a wider area, or actuation policies and traffic demand management, also offering the user information in real-time (VMS) or via the Internet. The Decision Support System will establish what is the best solution for the present situation, choosing from several alternatives, and providing the operator with a system for choosing a corrective measure.