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USE OF WEB BASED REAL TIME NOISE DATA TRASMISSION FOR ACOUSTIC INVESTIGATION AND MAPPING

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Abstract

The presentation describes how it is possible to implement an efficient automated publishing of long term real-time noise data on the web, through an overview of some critical technical aspects like the choice of acoustic parameters, the data transmission recovery, the post-processing capabilities. The presentation also examines the advantages of such systems for long term acoustic environment investigation, evaluation of the influence of other collected parameters on the actual noise environment, real-time noise mapping and validation of acoustic mathematical models, real-time noise information to the citizens.

INTRODUCTION

Noise pollution is an increasing problem that can be addressed and solved by a wide variety of methods, including a well-organized noise-monitoring network capable to collect noise data, both for short and long time periods. Such network should help technicians to obtain useful information to investigate the noise environment, without increasing too much the amount of the work for data processing and reporting. In other words, it is desirable to have a system, which can automatically organise original and/or processed data, in a convenient form for the next use. A system with those and even more capabilities was developed and installed in many locations in Italy as well as around the world. The developed system is also capable of publishing noise data on the web, and interfacing an acoustical mathematical model for automated noise mapping publishing as well. All those features permit a very efficient management of acoustical data and make easy to satisfy the Italian Decree D.Lgs. n. 194/2005 implementing the directive 2002/49/CE.

DESCRIPTION OF THE SYSTEM

The system consists of two main parts: the noise monitoring station(s) itself for noise data acquisition, and the central unit for data storing and publishing, which take place in a computer farm; those two parts communicate with each other by GPRS or ADSL network, and the Internet. Inside the monitoring station, which is based on a standard 01dB 'Solo' sound level meter equipped with outdoor microphone, there is a purposely developed special router, able to set-up the SLM, collect continuous data from it, and send them to the central unit over the selected transmission channel. The system can be powered with either internal battery or external power supply. In case of internal battery and GPRS transmission, the system can operate without any cable connection for a period of one week; in case of external power supply and ADSL connection, which permits a wider communication band, video and audio streaming are also possible. Figure 1 shows the block diagram of the complete system.

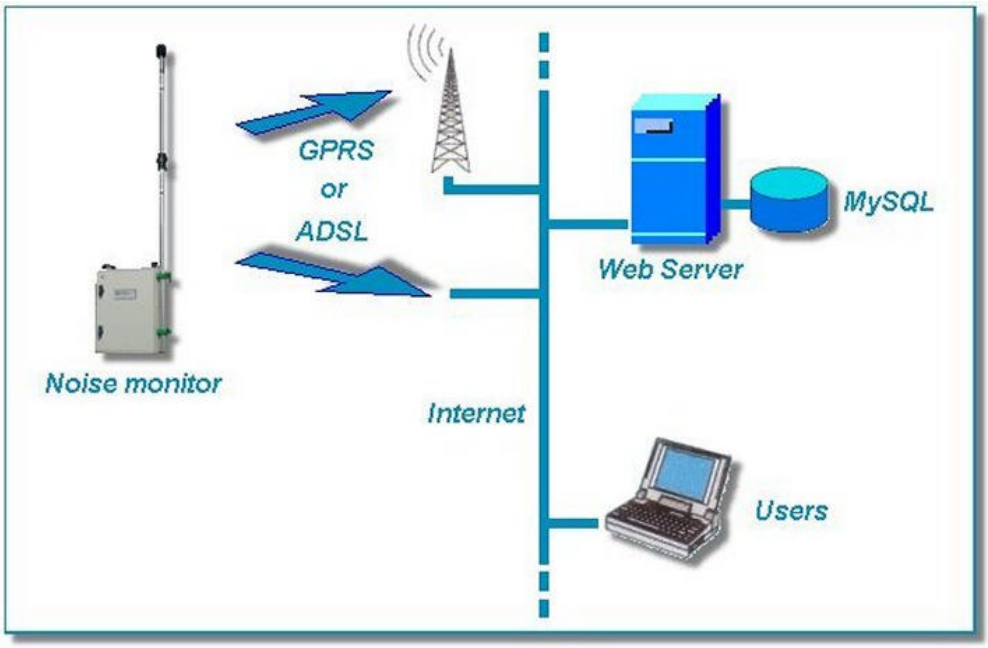

Figure 1 – Block diagram of the system

The outdoor box containing the complete monitoring station (i.e. SLM, power supply and router with GPRS or ADSL connection) is quite compact and suitable for both pole or railing mounting, as well as ground installation. Figure 2 shows a temporary ground installation with battery for one-week continuous operation on GPRS network. A more compact version of the system, suitable only for short-term operation, was also developed.

Figure 2 – Temporary battery operated installation with GPRS data transmission

MEASURED PARAMETERS

The choice of measured parameters was done by taking into account the need to collect sufficient detailed acoustic information, with a reasonable quantity of stored data. Although a complete set of data is normally preferred, the amount of data for long term monitoring application can became very huge, with consequent difficulty to post process them. Due to this reason, and by taking into account the limited bandwidth offered by the GPRS network too, a one second step 1/3 octave short L_{eq} spectrum, inclusive of A-weighted overall value, was chosen as maximum available data rate of the system; with those information is quite easy to recognise many different kinds of different events.

DATA TRANSMISSION AND STORAGE

While with ADSL it is possible to transmit big amount of continuous data without any problem, the real bandwidth offered by a GPRS connection is affected from the local actual data traffic, and sometimes it is not so difficult to experience a real bandwidth less wide than the expected one. In order to avoid data lack due to the abovementioned GPRS problem, the special router takes also care about some transmission optimisation like data compression, data flow managment, etcetera. After the transmission, all data are decompressed and stored in a MySQL database, which runs on the Linux machine in the computer farm. Each noise monitoring station in the field is hourly synchronized with a NTP server in order to make possible comparison of data coming from different monitoring stations operating in the same area. As an option a GPS receiver can be included in the system in order to obtain information about the location of the monitoring station, as well as a meteoclimatic station can be added for transmission of weather conditions by using the same noise monitoring station router. The system can be also interfaced with a different dedicated front-end, in order to acquire overall vibration data from a triaxial accelerometer within 100 millisecond steps, instead of the mentioned acoustic data; the vibration version of the system is suitable for monitoring vibration coming from trains, traffic, industries, as well as vibration coming from building site.

DATA RETRIEVAL AND PUBLISHING

All the stored data are available on a public or password protect web page, in real time or not, depending on the purpose of the measurements. When validation of measurements results is needed, data publishing could be allowed only after this step. By using a powerful server side language, the web pages showing noise data can include on-the-fly generated graphics like spectra, time histories, sonograms, and so on, with no need for special software or drivers: a standard web browser and Internet connection is all the user needs to display data on his own PC. Several examples of public working systems can be seen on the web at http://www.citynoise.net/ . Some of the monitoring station includes also advanced features like audio/video streaming and automated noise map generation. Figure 3 shows the web page of a system installed close to a railway: in the sonogram it is easy to recognise a short train event happened early in the morning, with the bell of the road-crossing that warning for the train passage four minutes before the event itself. Colour scale of the sonogram cover values between 20dB and 100 dB, the dynamic range of the shown time history is 80 dB, while the time scale of both graphics represent an interval of ten minutes.

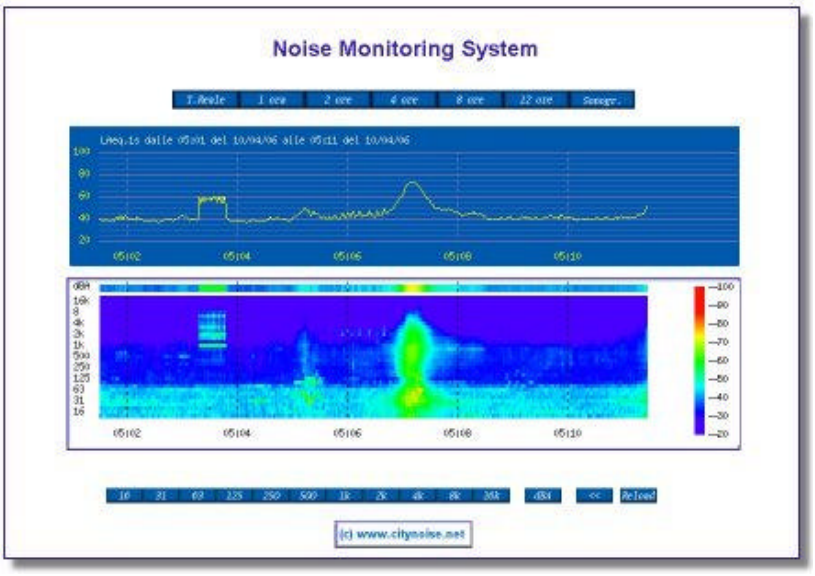

Figure 3 – Web page showing a short railroad event early in the morning

Figure 4 shows the same noise monitor during the afternoon: in the sonogram it is possible to recognise a different train event with front locomotive, and the bell of the road-crossing that warning for the train passage; in this case the event was more than three minutes long (it was a goods train) and a couple of whistles was emitted a little while before the train approached the crossing road;

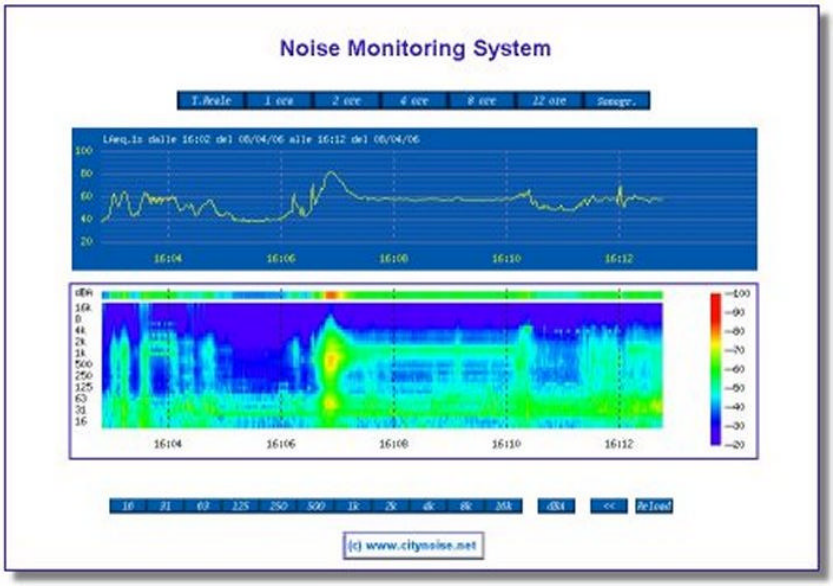

Figure 4 – Web page showing a long railroad event in the afternoon

AUTOMATIC WARNING AND REPORT GENERATION

The system can be programmed for automatic e-mail or texting (i.e. SMS) when a specific noise condition is reached (i.e.: threshold crossing). This function is very useful when deeper investigation is required, like on occasions when the noise pollution happens at unpredictable time. If a report template is defined, it is also possible to plan the automatic generation of a multipages pdf report, each day at a specific time, containing all the information defined in the report template, and its automatic e-mailing to all relevant person involved in the monitoring.

OFF-LINE DATA PROCESSING

All the stored data can be downloaded from a password protected administration web page, and can be processed with the appropriate software in order to display time histories, spectra, sonogram, or compute hourly reports, day/evening/night reports, cumulative and distributive curve for each frequency and so on. The original and the processed data can be also printed, and exported both in graphical and textual form.
A useful function of the system can provide daily automatically mailing of data set, to relevant e-mail address. Figure 5 shows the passage of a helicopter, displayed with the off-line software: doppler effect can be shown on the right bottom part of the sonogram.

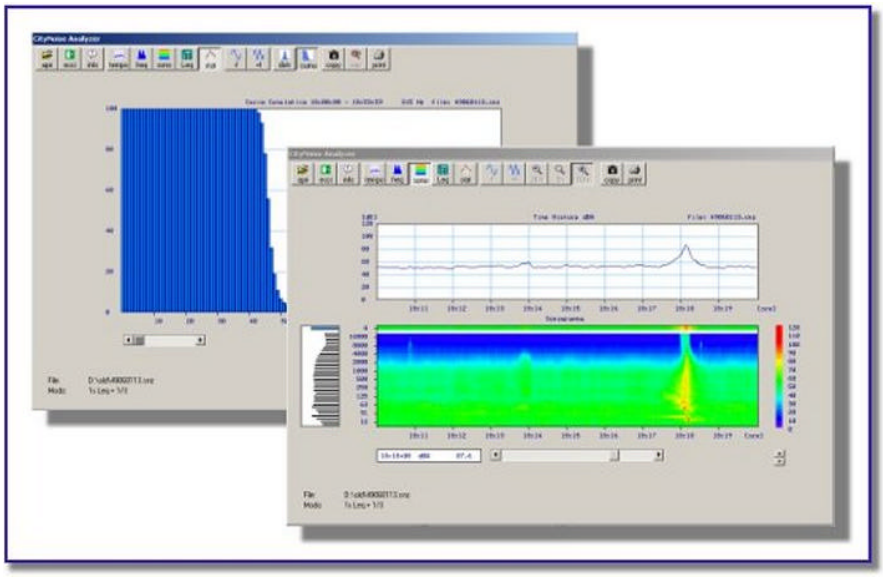

Figure 5 – Off line data analysis showing helicopter passage

NOISE MAPPING SOFTWARE INTERFACE

By using an appropriate noise prediction software which can communicate with the system, and capable to re-scale and re-combine partial pre-calculated noise map, it is possible to publish at specific time interval, the updated global noise mapping of the area, according to the measured noise values; in order to do that, the location of the monitoring stations should be chosen to obtain measurements which are representative of each sound source present in the considered area. Figure 6 shows the web page of an installation placed close to a motorway, equipped with camera and microphone for real time video and audio streaming, and with the abovementioned noise mapping capability.

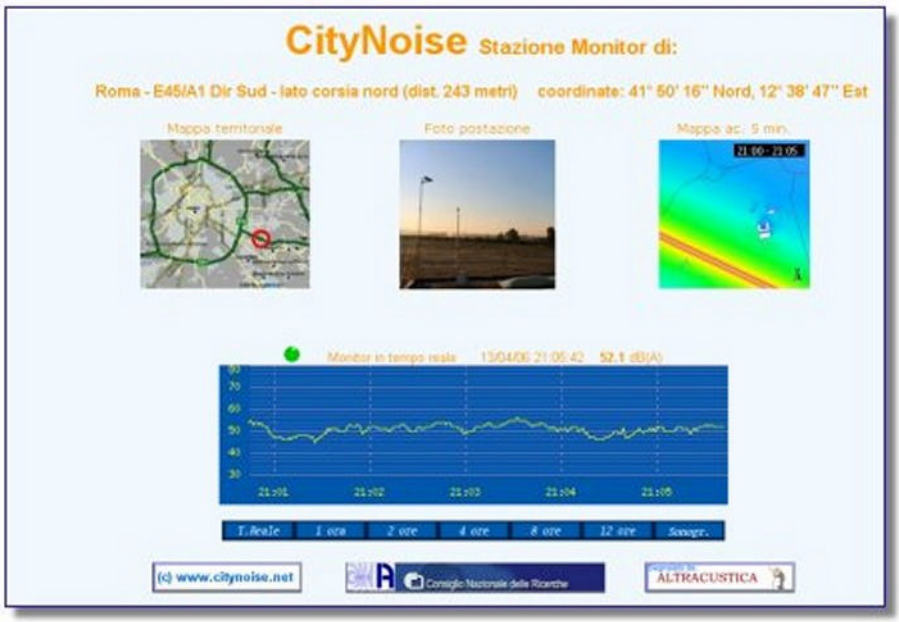

Figure 6 – Web page with noise mapping, video e audio streaming

CONCLUSIONS

A system like the described one can optimize daily work of people involved in investigation of acoustic environment, and is also suitable for the information to citizens about the noise environment in where they live. Main applications include noise monitoring of roads, railways, industries and building site. Moreover, the big amount of data that can be collected over long periods, combined with other parameters like meteoclimatic condition and traffic flows, could be very useful for many research purposes.

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