Development of low cost sensor networks for real time noise mapping

LIFE13 ENV/IT/001254

DYNAMAP July 2015
Administrative information

LIFE13 ENV/IT/001254
LIFE - DYNAMAP

DURATION OF THE PROJECT: 60 months (from 01-JULY-2014 to 30-JUNE-2019)
TOTAL BUDGET: 2,230,319.00 €
EU CONTRIBUTION: 1,063,274.00 €
PROJECT LOCATION: Lombardia, Lazio

Beneficiaries
ANAS - Project Management (Italy)
ACCON (Germany)
AMAT (Italy)
BICOCCA - University of Milan (Italy)
BLUE WAVE (Italy)
LA SALLE - Ramon Llull University (Spain)
MILAN MUNICIPALITY (Italy)

Links
http://www.stradeanas.it
https://www.comune.milano.it
http://www.unimib.it
http://beslasalle.salleurl.edu
http://www.accon.it
http://www.blue-wave.com
http://www.amat-mi.it
**The Dynamap Project**

DYNAMAP is a LIFE+ project aimed at developing a dynamic noise mapping system able to detect and represent in real time the acoustic impact of road infrastructures. Scope of the project is the Directive 2002/49/EC (END) of the European Parliament and of the Council relating to the assessment and management of environmental noise. Aim of the Directive is to define a common approach intended to avoid, prevent or reduce the harmful effects due to exposure to environmental noise. To that end, noise maps must be provided and updated every five years in order to report about changes in environmental conditions (mainly traffic, mobility and urban development) that may have occurred over the reference period. However, the updating of noise maps using a standard approach requires that authorities responsible for providing noise maps collect and process new data related to such changes. This procedure is time consuming and costly and has a significant impact on the financial statements of the authorities responsible for providing noise maps. As a matter of fact, many road administrations and local authorities are complaining about the huge financial effort of noise mapping activities. For this reason, the need for reducing costs, especially in conjunction with the current economic crisis affecting several European countries, has become a primary objective.

To facilitate the updating of noise maps and reduce their economic impact, noise mapping can be automated by developing an integrated system for data acquisition and processing that is able to detect and report in real time the acoustic climate due to noise sources. This approach seems quite promising in areas where noise sources are well identified, such as those close to main roads. In complex scenarios, such as in agglomerations, further considerations and testing are needed to make the idea feasible. Furthermore, the END states that simplified and easy-to-read noise maps are made available to inform the public about noise levels and actions to be undertaken by local and central authorities to reduce the noise impact on the environment. To that end, a suitable on-line database will be equipped with different access levels to deliver simplified data for the public and different levels of information to skilled and authorized users. Finally, the Dynamap System will be designed so as to be adaptable to other kinds of sensors collecting information requiring periodic assessment, such as air quality, meteorological and road conditions, traffic volumes, to provide a more comprehensive and integrated overview of the environmental impact of noise sources present in the monitored areas.
The **project idea**

The main project idea is focused on the research of a technical solution able to ease and reduce the cost of periodically updating noise maps, through an automatic monitoring system, based on customized low-cost sensors, and a software tool implemented on a general purpose GIS platform performing the update of noise maps in real time (dynamic noise maps). The update of noise maps can be rapidly accomplished by scaling pre-calculated basic noise maps, prepared for different sources, traffic and weather conditions. Basic noise maps are selected and scaled using the information retrieved from low-cost sensors continuously measuring the sound pressure levels of the primary noise sources present in the area to be mapped. In order to guarantee the accuracy of the updating process, noise levels are first cleaned up from anomalous events before being used to scale the basic noise maps. Scaled basic noise maps of each primary source are then summed-up to provide the overall noise map of the area. In this way, the need for several and expensive software license is extremely reduced and limited only to the preparation of the basic noise maps. The system foreseen in the DYNAMAP project includes the development of customized low cost devices to collate and transmit data, and the implementation of a simple GIS based software application for maps scaling with reduced calculation load. Such a standalone dynamic mapping software (no need of running modelling software), together with low cost noise monitoring stations, makes the DYNAMAP system a very efficient and versatile noise mapping tool, virtually able to interface any existing or future noise modelling software.

*Schematic representation of the DYNAMAP system*
**Objectives**

The main objectives of the projects are:

1. To automate the noise mapping process using the information retrieved from a low-cost monitoring network;

2. To develop low-cost sensors and communication devices to collect the information needed to update noise maps in real time;

3. To implement and test the system in two sites with different characteristics: an agglomeration and a major road;

4. To demonstrate that the automation process will lead to a significant reduction in the resources needed to update noise maps (time, costs and dedicated personnel);

5. To improve and ease public information through different system access levels to provide user-friendly information;

6. To check the possibility of improving the system with additional information to report multiple environmental data dynamically (air quality, meteorological conditions, etc.).

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**Project structure**

The project will be accomplished through four main steps:

- development of low-cost sensors and tools for managing, processing and reporting real-time noise maps on a GIS platform;

- design and implementation of two demonstrative systems in the cities of Milan and Rome. The first will cover a significant portion of the agglomeration of Milan, while the second will be located along a major road surrounding the city of Rome;

- systems monitoring for at least one year to check criticalities and analyze problems and faults that might occur over the test period. The test results will then be used to suggest system upgrades and extend implementation to other environmental parameters;

- provision of a guideline for the design and implementation of real-time noise mapping.
The pilot areas

The implementation of the DYNAMAP system requires the identification of suitable sites to be used as pilot areas for project demonstration activities. Two pilot areas are foreseen to test the different requirements associated to major roads and agglomerations. The first pilot area is located in the city of Milan and will cover a significant portion of the town, including different type of roads and acoustical scenarios. Roads will be classified and assigned to a suitable number of clusters, on the basis of traffic characteristics. Twenty four roads representative of these clusters will be continuously monitored to provide noise levels for the update of noise maps. Traffic data collected by on site available vehicles counting devices will be integrated in the dynamic noise mapping system to improve and refine noise maps with real traffic information. The second pilot area is located along a major road, i.e. the ring road (Motorway A90) surrounding the city of Rome. Sensors devices will be installed in hot spots where traffic counting is unavailable to feed the dynamic mapping system with real time information on noise levels. About 25 devices will be used to provide information on noise levels generated by the motorway and dynamically update noise maps. About one quarter of the ring road, for a total length of 25 km, will be equipped with the new sensors.
Expected results

The project is expected to provide seven main deliverables:

1. Development of low cost sensors - The project includes the development of low-cost sensors to measure the noise levels generated by the sources included in the mapping areas.

2. Development of a software tool for dynamic noise mapping - Data retrieved from sensors will be sent to a data management system, through a dedicated software application for real-time data management and processing.

3. Implementation of two demonstrative systems - The system will be installed and tested at two different sites: the first located within the agglomeration of Milan (Italy) and the second along a major road surrounding the city of Rome (Italy).

4. Test results of the systems - The system will be tested for one year in order to assess its reliability, detect and solve problems, determine its accuracy and calculate the uncertainty associated with noise maps.

5. System upgrade feasibility - The possibility of strengthening the system with applications for dynamic reporting of integrated environmental impacts (noise, air quality, meteorological conditions, etc.), will be analyzed.

6. Test results on public response and user ability in consulting and managing the system - The software tool will be structured with different data access levels assigned to authorized users. The tool will be tested to check public response and user ability in consulting and managing the system.

7. Dissemination - The project will provide for an extensive dissemination campaign based on traditional and web communication channels, such as conferences, seminars, workshops, papers, a dedicated internet site, social networks, smart-device applications and fora.

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