Chapter 69

GIS Approach for Collaborative Monitoring and Prediction of Environmental Noise in Urban Areas

Juan H. Juarez
Instituto Politécnico Nacional (IPN), Mexico

Marco A. Moreno
Instituto Politécnico Nacional (IPN), Mexico

Miguel J. Torres
Instituto Politécnico Nacional (IPN), Mexico

ABSTRACT

Environmental noise, as well as being a form of environmental pollution that affects mainly urban areas, it is a problem that involves people's quality of life. This paper presents a methodology that takes advantage of the Volunteered Geographic Information (VGI) in obtaining georeferenced environmental noise maps and the corresponding statistics for a particular area of interest. The methodology herein presented considers the phases of Data acquisition, Analysis and data processing, and Visualization of the information. The design and development of a Geographic Information System is presented, which consists of a web mapping application, an application for mobile devices, called NoiseMonitor, Geospatial Analysis and Machine Learning methods (Support Vector Machines and Artificial Neural Networks) for acoustic noise prediction using contextual information, that is, some factors around the measurements. A study case is based on Mexico City.

1. INTRODUCTION

Environmental noise is not just a form of environmental pollution, but it is also a problem that affects the quality of life of people, generate them stress and cause them progressive hearing loss and other health problems, such as hypertension and other heart problems (Antón & Antón, 2012). It has been found, for example, that prolonged exposure to traffic is associated with a small increased risk of death from

cardiovascular complications, especially in the elderly population (Halonen et al, 2015). According to the World Health Organization, noise is the second major cause of health problems, after the poor air quality. The high noise levels occur mainly in the most densely populated areas, such as Mexico City, one of the most populous countries in the world, so by answering questions on where and when different levels of noise are generated.

Geospatial technologies have given citizens the opportunity to participate actively and intentionally in activities that were once relegated to the world of expert geographers and cartographers. This can be interpreted as the beginning of a new geography but without geographers. Neogeography is a social phenomenon that describes the use of geographic tools and techniques by ordinary people; that is to say, they are a subset of users who voluntarily produce their own information, which has the quality of being information with geographic content (Connors et al, 2012, Goodchild, 2009). This is kind of applications derive in concepts as Volunteered Geographic Information (VGI) by Goodchild (2007). VGI is content generated in an intentional and conscious effort by the users community with little or no education, experience or training in geography or cartography, that is, by the neogeographers. This information helps expand the information from experts in the analysis of geographic information, such as the scientific community or private research organizations, so they can take advantage of both knowledge from expert and non-expert community (Connors et al, 2012, ; Elwood et al, 2012, Goodchild, 2009). Examples include Wikimapia, OpenStreetMap, GeoNames, GeoCommons and TierraWiki (Elwood et al, 2012, Goodchild, 2007 and Sui, 2008), crime and public safety, adventure and recreation activities (Parker et al, 2013) and timely response to natural disasters (Middleton et al, 2014).

VGI aims to reduce the gap between the work of the public, the researchers and the authorities responsible for taking decisions on environmental policies of public character (Connors et al, 2012), so it has been used in smart cities to optimize city operations to address environmental, social and economic issues (Nakano, 2015). Other methodologies have been developed to ensure the VGI's quality (Fonte, 2015).

Several environment projects that have been made taking into account the participation of citizens, are related to habitat restoration, public health, environmental planning, monitoring of water quality, health and preservation of forest and animal resources, management of forest fires, mapping and monitoring of crop fields (precision agriculture), humanitarian programs, etc. In fact, VGI establishes a new paradigm for socio-spatial research and the continuous monitoring of the changing landscape of social behavior and interaction in fast evolving urbanized societies, making VGI a big data phenomenon which cannot be conceived in isolation from other concepts of data science (Jiang and Thill, 2015).

In addition, the authors point out that this work is based on Smart city concept, which has been used to making better use of Information and Communication Technologies (ICTs) to improve the services that support urban operations and services. The rest of the paper is organized as follows, in the next section, some works related to noise monitoring including researches and applications are presented. Then, the authors present the methodology. Later, we show our study case, results and experiments. Finally, conclusions are shown.

2. RELATED WORKS

In this section, some works related to the generation of environmental noise maps and collaborative applications for environmental noise monitoring are presented.

25 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/gis-approach-for-collaborative-monitoring-and-prediction-of-environmental-noise-in-urban-areas/213006

Related Content

Harmful Effects of Ecosystem Impairment on Human Health
Suruchi Singh, Shashi Bhushan Agrawaland Madhoolika Agrawal (2018). *Climate Change and Environmental Concerns: Breakthroughs in Research and Practice (pp. 384-392).*
www.irma-international.org/chapter/harmful-effects-of-ecosystem-impairment-on-human-health/201713

Modeling Environmental Impacts on Viticultural Ecosystems: A First Case Study in a Regulated Wine Producing Area
Cyril Tissot, Etienne Neethling, Mathias Rouan, Gérard Barbeau, Hervé Quénoland Céline Le Coq (2019). *Environmental Information Systems: Concepts, Methodologies, Tools, and Applications (pp. 1403-1422).*
www.irma-international.org/chapter/modeling-environmental-impacts-on-viticultural-ecosystems/212999

Pesticides as Water Pollutants
Anamika Srivastava, Nirmala Kumari Jangid, Manish Srivastavaand Varun Rawat (2019). *Handbook of Research on the Adverse Effects of Pesticide Pollution in Aquatic Ecosystems (pp. 1-19).*
www.irma-international.org/chapter/pesticides-as-water-pollutants/213493

Research Methods and Tools
 (2018). *Innovative Strategies and Frameworks in Climate Change Adaptation: Emerging Research and Opportunities (pp. 22-37).*
www.irma-international.org/chapter/research-methods-and-tools/191156

Enhanced F-Perceptory Approach for Dealing With Geographic Data Imprecision From the Conceptual Modeling to the Fuzzy Geographical Database Building
Besma Khalfi, Cyril De Runzand Herman Akdag (2019). *Environmental Information Systems: Concepts, Methodologies, Tools, and Applications (pp. 426-455).*
www.irma-international.org/chapter/enhanced-f-perceptory-approach-for-dealing-with-geographic-data-imprecision-from-the-conceptual-modeling-to-the-fuzzy-geographical-database-building/212953