Chapter 21

Innovation on User–Generated Content for Environmental Noise Monitoring and Analysis in the Context of Smart Cities

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ABSTRACT

This work presents an approach based on the concept of Volunteered Geographic Information (VGI) to monitoring environmental noise; it is a problem that specially affects people's quality of life in urban areas. In this work, mobile devices are used to massively collect environmental noise measurements, which are used to generate maps of a specific area and then make a forecast. The difference of this approach with respect to the traditional methods based on monitoring stations is that it is much less costly, which is a major innovation in developing countries. This approach is based on a GIS approach that consists of an application for mobile devices and a web mapping application; including Geospatial Analysis and Machine Learning methods for the acoustic noise prediction using contextual information. With this approach it will be possible to define actions to mitigate the effects of environmental noise, it is aligned in the context of the smart cities. The proposed case study is based on collecting noise data of the Mexico City.

1. INTRODUCTION

User-generated content from social networks and other kind of web and mobile applications have grown as quickly as expected. This has proven useful for diverse applications related to geographic phenomenon as monitoring and reporting activities and events on urban environments. It allows citizens to collaborate actively by sharing their observations on specific situations. A key aspect of smart cities is the analysis of contextual information, close to real-time, to enhance the operations and services in urban areas; in specific to sensing some city phenomena in order to detect how, when or where it occurs. This work presents a novel approach based on the concept of Volunteered Geographic Information (VGI) to monitoring environmental noise; it is a problem that specially affects people's quality of life in urban areas. In this work, mobile devices are used to massively collect environmental noise measurements, which are used to generate maps of a specific area and then make a forecast.

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 it is important to answer 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

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