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Development of a GIS Application for Urban Forestry Management Planning

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Abstract

Green spaces are indispensable for the urban ecosystem. Benefits coming form trees, parks, urban and peri-urban woods can be the mitigation of temperature, pollution decreasing, protection from water run-off and soil erosion, aesthetics increasing and quality of places, providing a place for recreation, education and learning. Geographic Information Systems (GIS) helps cities manage forestry projects efficiently and reduce management costs. This paper presents the development of a GIS application for urban forestry management. For developing the GIS application, Geoserver, PostGIS/PostgreSQL, OpenLayers, GDAL, PROJ.4, and Entity Framework 5.0 were used. Further ASP.NET MVC4 was used for developing the web site of the application. The GIS application that was developed is an independent window application, which run in every modern computer with no need to be connected to any other software. Such a GIS application must do, this one supports the authorities to choose appropriate measures for urban forest management, protection and utilization by connecting attribute to spatial data. Conclusively this GIS application is an appropriate tool for Municipality Administration Services in cooperation with researchers and concerned citizens, for contribution to a better management of urban forests, providing urban population with better living conditions.

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Keywords: Urban forestry; spatial data; ASP.NET; digitizing data

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1. Introduction

Green spaces are essential to the urban ecosystem. Trees, parks, urban and peri-urban woods (green spaces categories included within Urban Forest) can mitigate temperature, decrease pollution, water run-off and soil erosion, increase aesthetics and quality of places, provide a place for recreation, education and learning. Trees can also contribute by direct and indirect ways to reduce CO2 in the atmosphere and contrast 'urban heat island'. As Paulelt and Duhme notice, comprehensive knowledge is needed on the status and performance of the urban forest in order to preserve an enhance it. In particular, information is required on the tree's spatial distribution within the city [1].

Cities manage their urban forests by spatially referencing their trees and using this information to select sites, monitor tree health and growth, schedule trimming and treatment and set policies for environmental development. Tasoulas and Andreopoulou [2] indicate that Information and Communication Technology (ICT) is a discipline that can be adequately exploited in many scientific fields, aiming to help local authorities/administrative in decision-making process. Thus, information systems have been widely used for environmental management issues and this diffusion affords many gains either to researchers or to the administrators. This diffusion has already intruded in urban forestry management and administrators exploits several software in order to make their management plans more virtual. Varras et. al. [3] marks that an urban forest management plan, based on recent tree inventory data and analysis of available staff, equipment, and budget resources, is an essential tool for protecting this valuable resource. According to Barker et al. [4] an urban forest management plan is an action plan; it gives public works agencies detailed information, recommendations, and resources needed to effectively and pro-actively manage public trees.

Geographic Information Systems (GIS) helps cities manage forestry projects efficiently and reduce management costs. GIS brings together different types of data for intelligent planning. A city's tree database may include tree location, species, diameter breast height (DBH), canopy width, condition, and growth recordings. In addition to tree attribute data, the urban forest planner can include other relevant features from the city's database such as streets, curb lines, building footprints, overhead and underground utilities, workforce areas, pest/disease quarantine zones, parks, and pending construction areas [5]. Tsirogiannis indicates that other attribute data concerning the trees can be soil, water and sun exposure requirements [6].

As known a GIS application can project different spatial data on different layers. Integrating different map layers into an urban tree management project improves insight for decision making. For example, the urban forest planner can easily localize zones with dense planting and zones with no planting, detect conflict cases for urban planting, measure the growth of the trees and estimate the probable effects by it's evolution in the next years, exploit the current irrigation systems in the best way, assess the tree canopy benefits [7] and many other uses. Moreover a GIS approach can also be a deserving tool for recording the people status estimation and will for urban forest. Germann-Chiari and Seeland [8] use GIS as an almost indispensable means of quantitative research, which must be supplemented by individual interviews or qualitative social research methods to obtain authentic assessments of the wishes and aspirations of concerned people. As Andreopoulou says [9], a rapidly evolving way for exploiting ICT's benefits is modern networks. The entrance in these networks can be free or restricted and the essential hardware is a desktop, a laptop, a tablet or a smart-phone, since mobile GIS can be alternative technology [10]. Thereby an intranet can be very useful for local authorities communication threw GIS and internet can be equally useful for dissemination of knowledge to the people and collecting data from them.

This paper presents the development of a GIS application for urban forestry management. The aim of this effort was to develop a stand alone GIS network platform for communication, cooperation and diffusion of the data among scientists participating in a research program and for establishing internet communication among concerned citizens. Digitizing the urban forests of the four major cities of Epirus Region in Greece, Ioannina, Arta, Preveza and Igoumenitsa by using this GIS application, was the first goal of the research program. Afterwards the digitized data could be exported from this application and imported to another application called Envi-met for producing bio climatic maps.