Presented at the DLSU Research Congress 2014
De La Salle University, Manila, Philippines
March 6-8, 2014

Tree Management System

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Abstract: Trees are known as a vital component of urban environments and the planting of trees in human settlements is not new. However, the basic information about trees such as their species, ratio and age are difficult to obtain in order to determine what kind of maintenance the trees will require. The chosen test bed was NUVALI since it is committed in ensuring the welfare of the natural environment through preserving and enhancing the existing ecosystems within their area. Its long term objective is to plant 100,000 trees within their buffer areas and wildlife and bird sanctuary. The main issue is the absence of systematic scheme of capturing tree information that can help in monitoring and maintaining trees. The main objective to resolve this issue is "to develop a Tree Monitoring and Mapping Information System that will capture and store all the necessary information of tree-related behavior and monitoring and maintenance activities in order to provide reliable and essential baseline data to NUVALI stakeholders. The methodology used for this study was the Waterfall Model and the tools that were used are Microsoft Visual Studio 2010, Microsoft SQL Server 2008, and Google Maps API. The group asked the users to evaluate the system in terms of the usability of the system, its functionalities, user interface and the integration with other modules. Based on the user feedback, the system got a high rating on the user interface and security and an average rating for functionality. Additional information about the trees such as the fertilizer used, type of soil and weather conditions can be added in the system to improve tree management. Also, it is good if the mobile application can have additional features of free SMS and camera application for data capturing.

Key Words: Urban Planning, Tree Management, Tree Monitoring, Information System, GIS, Vertical Portal

1. INTRODUCTION

1.1. Background of the Study

Tree planting in subdivisions and surroundings has always been part of the plan whenever there is a new subdivision being developed or a family moves into their new home either because of its relevance or tradition or religious beliefs. It has its roots in ancient Chinese, western Asian and Greek civilizations. Several ancient cities had highly developed parks, gardens and other green spaces—one of which is the most notable being Babylon, "the mother city of gardens,"

dating back more than 3,000 years. The Assyrian civilization and the classical Persian and Greek civilizations also had such tradition which was actually based on amenity as well as cultural and religious beliefs.

Later, the elite people, particularly those in European cities such as Italy, France and England, started to develop urban gardens and parks as visual amenities. Thus, the practice of urban amenity plantings subsequently spread to colonies in Africa and Asia. Throughout history, the planting and management of trees and forests has been based much more on aesthetic and spiritual values than on utilitarian benefits (Kuchelmeister and Braatz, 2011).

Only when urban forests are healthy and free from serious hazards do they add value to the urban community. Unhealthy and hazardous tree can diminish urban forest benefits and for this reason, trees should be monitored periodically to detect early the disorders and hazards of a tree. If trees are monitored periodically, appropriate actions can be done to maintain forest health, safety and value (Winn, 2001).

1.2. Relevant Developments

Efforts in greening and reforestation of urban forests are also increasing nowadays especially that different greening projects are being implemented not only by the government agencies such as MMDA, DOT, and DENR but also non-profit organizations and schools (e.g. Luntiang Pilipinas and One Million Trees and beyond). The recent calamaties (Bohol earthquake and super typhoon) have affected the greening efforts in the countryside. Tree conditions need to be checked/monitored. The Luntiang Pilipinas project is a nationwide urban forestry program committed to the promotion of environmental protection and awareness of Filipinos. It was founded almost a decade ago and has already drawn partnerships with various government agencies, private business partners, schools and universities, and non-government organizations in its aim to establish forest parks in their respective localities and establishments. It has since planted more than two million trees in 33 provinces and 28 cities. (Luntiang Pilipinas, n.d.) On the other hand, the One Million Trees and beyond (OMTB) is a project for the environment driven by the LaSallian Family through the LaSallian Institute for the Environment (LIFE). LIFE is a SEC- registered organization focused on the environment. OMTB have already planted in numerous rural and urban sites. (One Million Trees and Beyond, n.d.)The urban sites wherein the OMTB had already planted include Las Pinas, Quezon City, Pasay City and Tagaytay City.

According to an article, 'Poor or inadequate information on tree maintenance is one of reasons why trees are dying. A health assessment in 2003 showed that 72% of recently planted trees were in failing health. Poor stock quality, inadequate planting and maintenance practices, lack of water and poor soil were identified as contributing factors' (Lane, S, n.d.). This can be also true in the case of Philippines.

One solution to address the issue of maintaining trees is a tree inventory, especially for managing urban tree population on a tree by tree basis. This can be used for trees in subdivisions, campuses and universities, and street trees. The data record for each tree includes information about tree characteristics, maintenance history, and management needs. The data that is maintained for each inventoried tree will depend on the tree program's needs,who will be collecting the data, and the role that the inventory plays in the tree management program.

1.3. Objectives and Scope of the Study

The main objective of the study is to develop a Tree Monitoring and Mapping Information System that will capture and store all the necessary information of tree-related behavior and monitoring and maintenance activities in order to provide reliable and essential baseline data to the users to help them make decisions. Specifically, it aims to: conduct a study on the different worldwide and local concepts of urban forestry management and its approaches; analyze all the advantages and disadvantages, strengths and weaknesses of the current and past Information systems created and used by other countries for Urban Forestry; design a new approach for Urban Forestry with the integration of ICT; improve the process of the management where they will get objective results rather than subjective ones for decision-making; and show the environmental impacts and benefits of urban forestry in an

urbanized area.

The test bed company is Nuvali "located in the cities of Sta. Rosa, Calamba and the Municipality of Cabuyao in Laguna, part of the growth corridor of the CALABARZON Region" (Source: Nuvali.ph).

The system is a vertical portal for the users which are all concerned actors in urban forestry. The proponents will mainly focus in the processes of monitoring trees which revolve about the trees' growth, survival, and performance. It will also include a module for identifying a tree which will guide the personnel in plotting trees. The functionalities of the system are mostly for the demands in knowledge of NUVALI management which is just recently initiating the Urban Forestry in its respective area. Tools that will be needed in using the system will be devices that are internet-capable. The tools used to create the system are the following: Microsoft Visual Studio 2010, Microsoft SQL Server 2008, and Google Maps API.

2. METHODOLOGY

Based on the data gathered from the literature and interviews conducted with the users, the proponents have identified the main problem in terms of tree management which is the absence of systematic scheme of capturing tree information. It was noted that the following sub-problems exist during the conduct of the study: inadequate records of monitoring or maintenance activities; insufficient and subjective quarterly/annual reports; no single repository for data gathered; and information regarding the trees in the area is not consolidated.

Waterfall methodology was used since it follows a step-by-step process. The emphasis is on requirements and design to ensure that every aspect has been considered before starting with the coding.

3. RESULTS AND DISCUSSIONS

Based on research and interviews conducted by the proponents, they have identified the absence of systematic scheme of capturing tree information that can help in monitoring and maintaining trees as the main problem. There are three sub-problems identified and these are as follows: inadequate records of monitoring or maintenance activities, insufficient and subjective quarterly/ annual reports and there is no single repository for data gathered.

To address these problems, the proponents came up with the Tree Management System (TMS) for the Nuvali's property management office and homeowners of subdivision within Nuvali.

The Tree GIS Module allows the plotting of classified trees into the system's digitized map in a mobile application. Tree classification focused on the tree's growth, survival and performance. The map in the web application will be visible to the personnel, Nuvali community and the public. In mapping trees, community can add alerts needed for corrective actions with the trees such as pruning needs, infected by disease, blocks their surrounding and such (Figure 1). It will notify the management which initially validates the credibility of reported alert and once validated, actions made will be recorded in the database. This module is integrated with Google maps, both in mobile and web applications, since it is an open-source.

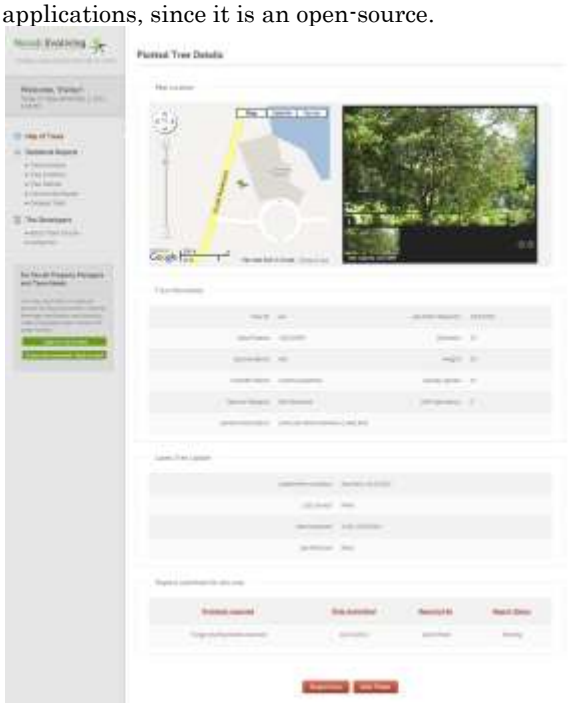


Fig. 1. Reporting a Tree Screen Shot

The Scheduling Module allows the management to schedule tree maintenance and the type of maintenance on a per tree or per area basis. This includes fertilizing, pruning, and measuring

growth and changes in the tree. This is presented in a digitized calendar of schedule (Figure 2). In addition, it will also alert and locate the scheduled trees for care maintenance which will easily guide the personnel on where these trees are currently located especially with the use of a handheld mobile device carrying the extended version of the proposed system.

Fig. 2. Calendar of Scheduled Tasks

The Tree Inventory and Maintenance Module allows the user to update the tree inventory specifically the trees' physical structure because one of the importance and success in monitoring trees are its growth. Annual measurement is a basic milestone in evaluating trees' growth. However, the intervals may vary depending on NUVALI's instructions and guidelines. Measurements of trees are the critical data needed in tree inventory and in monitoring trees. In this module, the personnel will be inputting correct measurement of tree's trunk and crown circumference, height, and other important details such as date measured and so on. This process must depend on the scheduled tree care maintenance for better guidelines to the personnel. It also compiles the specific actions taken with specific tree where the details could enhance the report needed from the management especially in decision-making such as tree removal, thorough pruning and fertilizing, and so on.

The Forecasting Module provides an accurate estimation of the possible outcomes on trees. This will include, but not limited to, determining and predicting the trees' life expectancy and growth (Figure 3).

The system generates reports regarding the total trees planted, total types of trees, average tree growth, average tree performance, the current actions undertaken by the personnel and such. These reports are used for assessing the urban forest development which in turn, can be used as information for planning purposes.

Fig. 3. Tree Specie Distribution and Forecasted Count

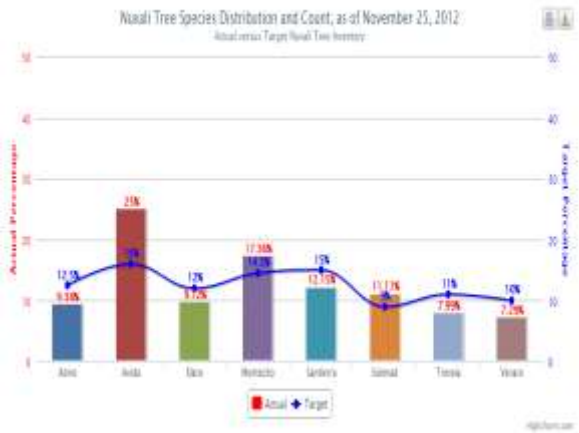
4. CONCLUSIONS

In this project, the group found out that the main problem of the company is that there is no systematic way of capturing tree information that can help in having reliable baseline data for decision-making purposes. Hence, Nuvali is not able to maximize their overall processes. Because of this, the group aims to improve the way Nuvali takes care of the trees through developing a Tree Management Systems. Along with this objective is that it should be able to capture and store all the necessary information of tree-related behavior and monitoring and maintenance activities as well as get objective results rather than subjective ones for decision-making. Moreover, the group also wants to make urban forestry be known by many because the focus right now is more on the rural areas and that is through making an approach with urban forestry via the integration of ICT.

The TMS (Tree Management System) is a system that has integrated mobile and web modules that can be very useful to Nuvali. TMS is equipped with the capabilities and features where we can analyze all the data involved in a faster and more effective way - where future problems can already be solved or might even be prevented. The group is also able to streamline the process of Nuvali and made the data available in real time for the members which results to faster decision making.

New features that can still be integrated in the existing TMS are system support and maintenance features. An interactive online chat or online assistant is a very good addition to the system especially that there may be users which will experience problems while using the system. Also, it is good if the mobile application can have additional features of free SMS and camera application for data capturing. As for the maintenance, the group recommends in adding a scheduled back-up which will notify the users or the ones mainly handling the system so that data is highly protected and secured from any future problems. Facebook and Twitter can be integrated in the system for the users to share how they have participated in helping maintain trees and this can somehow motivate others to do the same.

5. ACKNOWLEDGMENTS



The group would like to express their gratitude to the IT Department for guiding the proponents in being able to complete this project. Also, Nuvali administrators were very helpful in providing us with the information that we need and for allowing us to plot the tree locations in the map and for taking pictures of the trees.

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