VISUALIZATION AND GEOTAGGING OF SELECTED MANGROVE SPECIES IN DAVAO DEL SUR

RHEA MAE L. PERITO
SPAMAST, Institute of Education and Information Technology

ABSTRACT

Article History

Received: 22 March 2020
Revised: 25 August 2020
Accepted: 2 November 2020
Published: 30 January 2021

Keywords—Mangroves, visualization, geotagging, rapid application development, convolutional neural network, fisheries

The purpose of this study is to aid the Bureau of Fisheries and Aquatic Resources (BFAR) in monitoring the mangrove ecosystem. The android application provides modules that will capture and/or store mangrove details; geotagging of mangrove data, which will utilize Google maps for Davao del Sur; generate graphs presenting the total number of fully grown trees and propagules; establish an online database to sync locally captured data. Moreover, the leaf identification module was also developed as an added feature, where mangrove species have been identified according to their leaf features using the CNN classifier. The application development was carried out through the Rapid Application Development Model as a methodology. The study has been found successful in to its objectives, yet recommendations have been laid down. It has been recommended that the application should be dynamic in terms of modifying parameters of mangrove details; consider other mangrove species to be captured and/or stored; include indicating on what barangay the mangrove forest has been located to improve the usability of the project; use

android phones with high GPS capability to attain minimal error on fetching coordinates; graphs API used must be locally hosted so that graphs will be loaded even without internet connectivity.

INTRODUCTION

Due to fish pond activities, the Philippines has lost 50% of its original mangrove forests (Primavera, 1995). Cutting mangroves for fuel wood and construction materials by coastal residents is also common in the Philippines, contributing to the continued degradation of remaining forests in many areas (Walters, 2000). Mangrove reforestation and management, on the other hand, are now being enthusiastically promoted by governments, non-governmental organizations, and aid agencies throughout South and Southeast Asia (Melana, 2000).

In the Philippines, the national government, in particular, the Bureau of Fisheries and Aquatic Resources (BFAR) and the Department of Environment and Natural Resources (DENR) (with support from all Philippine law enforcement organizations) have national mandates for coastal resource management. The local government, on the other hand, is tasked with managing municipal waters and serving as front-line stewards of food security through sustainable coastal resource use and regulation (Parras, 1998).

According to Samson and Rollon (2011), in the Philippines, laws and administrative orders for the rehabilitation and protection of mangrove areas, as well as the responsible use of brackish-water ponds, are in place. As added by Parras (1998), the government identified opportunities for multi-sectoral collaboration and partnerships, which include LGUs, national government agencies, academic institutions, the private sector, and donor-funded projects.

The Community-Based Mangrove Resource Rehabilitation Management Project of Southern Philippines Agribusiness and Marine and Aquatic School of Technology (SPAMAST), in partnership with the Bureau of Fisheries and Aquatic Resources (BFAR), developed a strategic assessment and evaluation of the area for planting activities and monitoring of its growth, launched in 2013 and ending in 2015. Moreover, the project stored mangrove-related information. However, access to this information online was not established, and an issue of quick retrieval of such information exists.

In the study by Brisby (2017), he pointed out that there is a resonance between the needs of biodiversity science and the Internet's opportunities for globalization and interoperability. One is that biodiversity workers are scattered all over the world, literally in every country and on every island. In this context, the availability of mangrove-related information in Davao del Sur is relevant locally and globally since this will aid the decision-makers from the government and other sectoral agencies in the promotion of ecological conservation and rehabilitation.

Governments worldwide have established programs to address mangrove reforestation, including formulating tools that will aid such mangrove management. Some of these tools have something to do with Geographic Information Systems. According to Krause et al. (2004), GIS has a significant advantage for all types of environmental management because it can store information gathered in long-term monitoring programs, capturing the wealth of knowledge passed down from one generation of managers and researchers to the next. The usefulness of such tools, however, is dependent on the quality of the data and the availability of information on geometric accuracy.

To date, some mobile applications, including Leafsnap and i-Tree, implement location-based services through GIS and have been deployed for plant identification and ecological investigations of vegetation in the cities of Virginia, USA (Heavers, 2017). An iPhone application called "Mapping Native Plants" was also developed, which aims to give the power of the map to the people and not just to scientists and other specialists. Users can geotag the location of native plants, learn the plants' native names, and read about how native plants have been used for thousands of years (Wahl, 2013). However, mangrove trees weren't a part of the scope of these applications; thus, it was never implemented in the Philippines.

During the CBMRRM project of SPAMAST and BFAR, a method of tagging each project site's geolocation was developed through the aid of Google Earth Free Edition. Nevertheless, the researchers were limited to tagging the coordinates. Additionally, it didn't aid in the establishment of a database where users can access mangrove information quickly and openly. Another means established in the project for presenting information was through a visualization, where graphs were generated using MS Excel.

Gleicher et al. (2011) pointed out in their study that understanding, analyzing, and communicating data required the use of visualization tools. When working with complex data, comparison is frequently used in information visualization. Comparison tasks can be found in a variety of domains, including biology, network analysis, organic chemistry, medical physiology, and homeland security, as well as data objects such as graphs, tabular data, and surfaces. Steele and Iliinsky (2010) added that a successful visualization provides access to information; thus, the user may gain knowledge. A visualization that does not meet this goal will fail.

In addition, during the duration of the project, problems existed relating to the identification of mangrove species in the field since there was a lack of enumerators. These people were tasked to do the inventory of the dominant mangrove species in the assigned area. Yet, issues of doubt on which trees to be counted sprang up due to the unfamiliarity with each species' characterization, specifically on Bakauan, Pagatpat, and Piapi.

Putting into hand all of these actualities, this project intends to address the issues elaborated on in the previous project on supporting mangrove reforestation and information management. Thus, this study offered an extension of the said project. This would develop a technology that would visualize and tag geolocations of mangrove information in Davao del Sur. An additional feature of capturing and identifying mangrove leaf images had also been taken into consideration.

MATERIALS AND METHODS

Conceptual Framework

Figure 1 depicts the conceptual framework of Visualization and Geotagging of Selected Mangrove Species in Davao del Sur. It illustrated the concept of describing the structure of the information process.

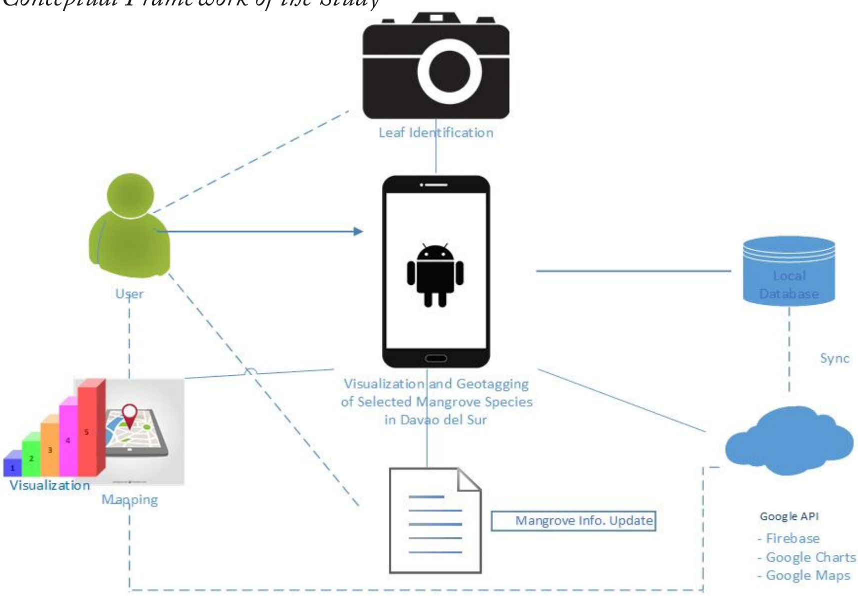
The researcher employed three functionalities: visualization (map and graph); mangrove information update; and leaf identification. The 105 users had the capability of identifying the captured image of a mangrove leaf.

Once the image was identified as one of the species described in the objectives, the application will automatically direct to the next functionality which is the mangrove information update. This functionality enables the user to input the data required.

After the input has been submitted to the database, the populated records can already be viewed on a map and graph as a visualization.

A locally based database, SQLite, was used in this application and automatically syncs with Firebase if an internet connection is established.

Figure 1
Conceptual Framework of the Study



Mangrove Details Update.

In this module, the user has the capability of storing mangrove details (species name, number of fully grown trees, number of propagules, forest hectareage, municipality where it has been planted, and geolocation). Automatic fetching of current coordinates has been designed once the form is loaded. Once all the inputs are keyed in, the user may submit the data to the database.

Furthermore, this study utilizes an SQLite database in storing the data locally, which is an in-process library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine. It has been used best in mobile applications that don't need online connectivity.

In the case of the detection of internet connectivity, the database automatically syncs to Google Firebase's cloud-based database.

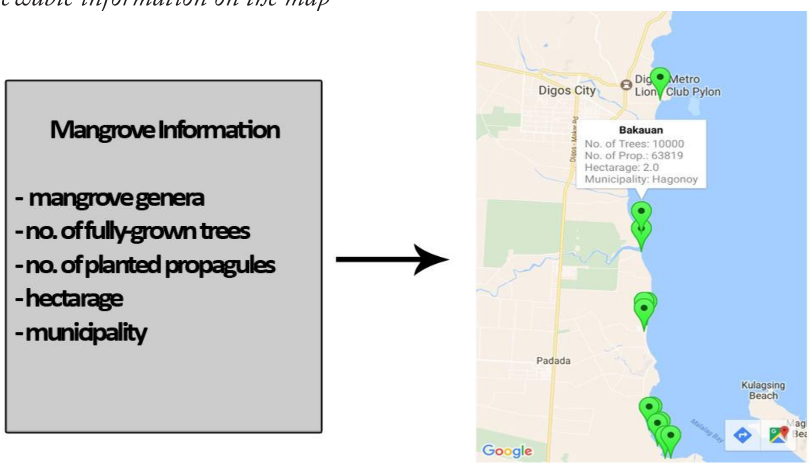
Mangrove Geolocation Tagging/ Mapping

This study utilizes Google Maps API V2 to plot the mangrove information for the five (5) municipalities and one (1) city of Davao del Sur.

Shown in Figure 2 The input information and viewable interface utilize a map. It is designed so that for each row in the database, a place marker will be pinned to the map. Along with the placemark, a snippet will be loaded with all the details of the mangrove.

Figure 2

Viewable information on the map



The project was been deployed on a mobile platform, specifically on Android phones. Android Studio Version 2.3.2 was its primary Integrated Development Environment (IDE). Program codes were written in Java Language and interfaces in XML coding.

Visualization using Graphs

To implement data analysis functionality for municipalities, the Google Charts API was employed. The graphs will present the total number of fully grown trees and the total number of propagules for each mangrove species per municipality. Furthermore, the researcher used a bar graph. A bar graph is commonly used in presenting data with two dimensions.

Mangrove Leaf Features Analysis

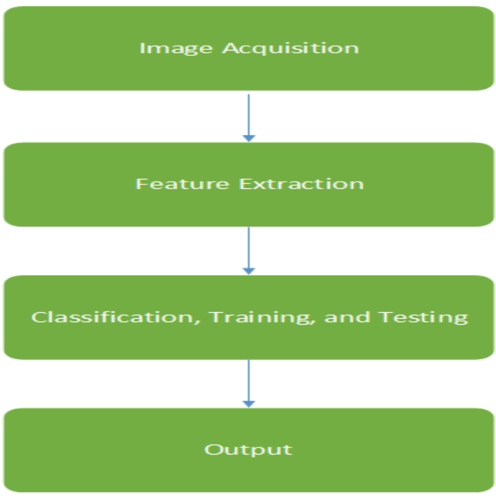
A theoretical approach is applied based on the algorithms and methods used in the applications that already exist. These algorithms are tested to provide relevant results in analyzing mangrove leaf characterization and texture.

The proposed methodology for this study, shown in Figure 3, consists of 4 steps, including input/image acquisition, feature extraction, classification, training, and testing, and displaying the final result.

Thus, these steps will be undergone through the integration of the TensorFlow Android API and the Inception v3 architecture model.

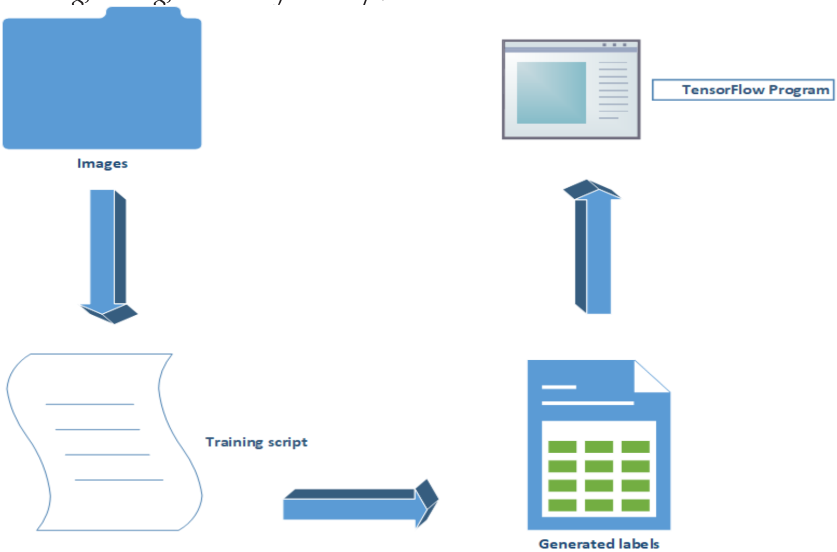
Figure 3

Methodology for Leaf Identification



The extracted color planes and geometric features of images it is then used in training the classifier. The training model used in this study is the Inception v3 architecture model, which is performed in a Python environment. This produces a new trained model _le that can be loaded and run by any TensorFlow program, as shown in Figure 4.

Figure 4
Training, testing, and classification phase



RESULTS

Based on the results presented, the researcher strongly believes that the objectives of this study have been satisfied. A module that will capture and/or store mangrove details has been developed and achieved through the mangrove information update module. Thus, the user can check the vegetation of the mangrove forest in Davao del Sur through the visualization module.

This module is comprised of mapping and graphs. The map showed how many areas in the province are planted with mangrove trees and propagules.

Furthermore, through the graphs, the user can now check which municipality has rich vegetation and which area needs replanting. Moreover, the leaf identification module was also developed as an added feature, where mangrove species have been identified according to their leaf features.

CONCLUSIONS

Based on the results of the study, the following conclusions are drawn:

1. A module that will capture and/or store mangrove details has been provided. Thus, there were two (2) manners developed in doing such capture and/or store: (1) through map activity that will verify first what species the user found in the mangrove area, it will then proceed to mangrove update information module if the image is identified as mangrove leaf and (2) direct access of mangrove update information module which is a better option if the user is already convinced what species to be stored in the database.
2. Geotagging of mangrove data, which will utilize Google Maps for Davao del Sur, has been done by the user. Location coordinates have been fetched and loaded automatically using Google location services. Thus, accurate mangrove information has been loaded into the snippet of each placemark, which is fetched from the database.
3. Visualization has been provided in the form of graphs. The application has generated the number of fully grown trees and the total number of propagules for each species. Presented alongside are the numerical values of trees and propagules for each municipality and species.
4. An online database to sync locally captured data has been established using the Firebase cloud-based database. Real-time synchronization has been implemented for the user.

REFERENCES

Brisby, F. (2017). The quiet revolution: Biodiversity informatics and the internet. Retrieved from http://kctc.kribb.re.kr/pdf/biodiversity2.pdf (accessed May 28, 2017)

Gleicher, M., Albers, D., Walker, R., Jusufi, I., Hansen, C. D., & Roberts, J. C. (2011). Visual comparison for information visualization. Information Visualization, 10(4), 289–309.

Heavers, N. (2017). Plant identification and mapping in the digital age: Historical and contemporary perspectives. Retrieved from http://architecturemps.com/wp-content/uploads/2013/09/heavers-nathan_plant-identification-and-mapping-in-the-digital-age.pdf (accessed May 9, 2017)

Krause, G., Bock, M., Weiers, S., & Braun, G. (2004). Mapping land-cover and mangrove structures with remote sensing techniques: A contribution to a synoptic GIS in support of coastal management in North Brazil. Environmental Management, 34(3), 429–440.

Melana, D. M., Atchue III, J., Yao, C. E., Edwards, R., Melana, E. E., & Gonzales, H. I. (2000). Mangrove management handbook. Department of Environment and Natural Resources, Manila, Philippines, through the Coastal Resource Management Project, Cebu City, Philippines.

Parras, T. (1998). Fish and food security 3. Retrieved from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.505.7760&rep=rep1&type=pdf

Primavera, J. H. (1995). Mangroves and brackishwater pond culture in the Philippines. In Asia-Pacific Symposium on Mangrove Ecosystems (pp. 303–309). Springer, Dordrecht.

Samson, M. S., & Rollon, R. N. (2011). Mangrove revegetation potentials of brackish-water pond areas in the Philippines. In Aquaculture and the Environment–A Shared Destiny (pp. 31–50). InTech, Rijeka.

Steele, J., & Iliinsky, N. (2010). Beautiful visualization: Looking at data through the eyes of experts. O'Reilly Media, Inc.

Wahl, M. A. (2013). Mapping native plants: A mobile GIS application for sharing indigenous knowledge in Southern California (Master's thesis). The University of Southern California.

Walters, B. B. (2000). Local mangrove planting in the Philippines: Are