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Identification And Classification Of Mangrove Trees Based On Morphological Specialization And Monitoring Their Spatio Temporal Distribution Using Deep Learning Techniques

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ABSTRACT

Mangroves are receiving increasing attention from government and non-government organizations around the world due to their ecological importance and benefits to the mankind. Experiences have proved that the presence of mangrove ecosystems on coastline save lives and property during natural calamities such as cyclones, storm surges and erosion. These ecosystems are also well known for their economic importance. The mangrove trees are susceptible to severe threats like Natural and Exploitation. These threats destroy the ecosystem as a whole or a subset of the system. The objective of this paper is to identify and classify mangrove trees based on their morphological specializations and monitoring their spatio- temporal distribution to protect them and further to save the ecosystem.

KEYWORDS:

INTRODUCTION

Trees can be differentiated by their varying structure with attributes such as Species, dbh(Tree diameter at breast height) in crow, height, aerial root, leaves, etc. From the classification of trees, trees which are rotten or infected can be identified and preserved from further deterioration.

The location of Mangrove forest in Pitchavaram is considered for the study. The Mangrove forest at Pichavaram, tamilnadu is located atLatitude11.432 and longitude79.780. Remote sensing is one of the essential tool that is adopted for forest monitoring and control. It can import spatio temporal land-cover data to detect the interactions between changes in land with population under that scenario. Monitoring the spatiotemporal distribution of mangrove forest is essential for preserving our eco system.

The commonly occurring diseases in mangrove include branch cankers, leaf spots, leaf loss, die back and stem rot. Stem and branch diseases of mangrove trees are identified from the galls. Galls are abnormal growth that happens on roots, leaves or twigs. Most galls are formed as the result of infections caused by bacteria or fungi. This paper aims to identify the diseases caused by fungi and bacteria. According to a study done by Swaminathan Research foundation, Chennai Identification of diseases is done with Deep learning. Deep Learning is a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks.

LITERATURE SURVEY

M.A. Roslani et al (2013) have used a multispectral RapidEye satellite image was used to identify the mangrove vegetation species within the Matang Mangrove Forest Reserve in Perak, Malaysia using texture analysis. This is carried out with remote sensing data. Classification was implemented using the maximum likelihood classifier (MLC) method. Eleven main mangrove species were able to capture using a satellite image. The remote sensing data used is rapid eye 2011, which is a German satellite with five satellite constellations being launched during August 2008. Anne F Van Loon et al (2016) have classified the mangroves growing in Malaysia into 5 categories based on the variables like tidal regime, elevation and flooding frequency. In most of the restoration sites, hydrological conditions can change quickly because of micro-topography and the presence of dikes and levees.

A number of fungal diseases happening to mangroves are identified. The exact number of families and genera of mangroves is yet to be identified. The most important families among mangroves is Avicceniaceae, composed of one genus and eight species and the Rhizophoraceae consisting of 16 genera and around 120 accepted species. True mangroves are characterized by viviparous reproduction, specialized structures such as aerial roots (pnematophores), which are used for gas exchange. Recent studies have shown that true mangroves called as halophytes are prone to high salt tolerance and mangrove associates are glycophytes with only less degree of salt tolerance, J. Alexander Osorio et al (2016)[11,12,13,14].

C. Giri et al (2010) have estimated the status and distributions of global mangroves and is mapped using Global Land Survey(GLS) data and Landsat archive. In this approach around 1000 Landsat scenes were interpreted using supervised and unsupervised digital image classification techniques. Each image was normalized and the digital numbers representing the difference between solar- angle and earth-sun distance is converted to atmosphere reflectance[15,16,17]. Ground truth data and existing maps and samples were used as training data. Results were validated using existing GIS data and the built-in training data to classify “true mangroves”. The role of storm-based sediment subsidies are required to predict future recovery patterns, Ken W. Krauss and Michael J. Osland (2019).

Gayatri R. Nambiar and K. Raveendran (2009) have identified thirty two manglicolous marine fungi along the kerala coast in India. The number of fungi was found to be more in Avicennia than in Rhizopora. K.R.Sridhar (2013) has estimated the Mangrove fungal diversity of west coast of India. Many categories of fungi exist in mangroves such as decomposers, epiphytes, endophytes and pathogens. Mangrove fungi including endophytic fungi produces useful bioactive compounds which helps in bioremediation. Among various tropical locations, tropical asia shows the highest number of fungi[18,19].

SYSTEM ARCHITECTURE

This objective can be carried out by the following steps and the overall architecture is depicted in Fig.1.

- Remote sensing is used to identify the areas of mangroves
- Images are captured by a Drone.
- Image enhancement is done and processed using discrete wavelet transformation.
- Features are extracted using Textual features and Morphological features and classification is performed with techniques like KNN,SVM and Deep Learning.
- The classification accuracy is performed using Overall Classification Accuracy (OCA) and Sensitivity.

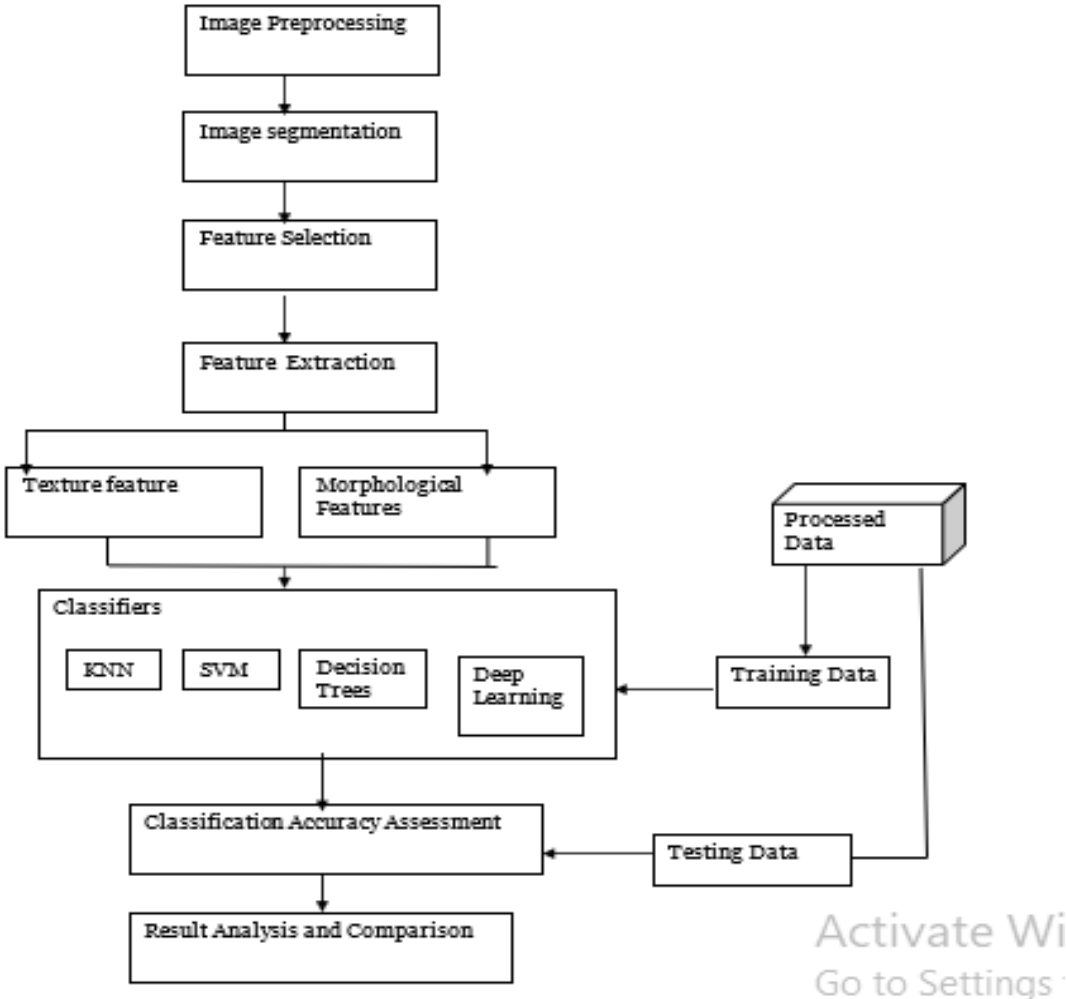

Fig. 1 Overall Architecture

Remote sensing is one of the essential tool that is adopted for forest monitoring and control. It can import spatio temporal land-cover data to detect the interactions between changes in land with population under that scenario.Monitoring the spatiotemporal distribution of mangrove forest is essential for preserving our eco system.

Image Preprocessing:

Digital image processing uses efficient algorithms to perform image processing on digital images. Digital image processing can be done by :

- Classification
- Featureextraction
- Multi-scale signalanalysis
- Pattern recognition
- Projection

Based on the morphological specializations provided, the original image and the captured image is compared. Comparison between the two images is performed to calculate the accuracy of the image.

Preprocessing is done by Hidden Markov Models (HMM). HMM is a statistical model in which the system being processed is assumed as markov process. The task is to compute, given the model's parameters and a sequence of observations, the distribution over hidden states of the last latent variable at the end of the sequence. This task is normally used when the sequence of latent variables is thought of as the underlying states that a process moves through at a sequence of points of time, with corresponding observations at each point in time.

Feature Extraction :

Feature Extraction is done through Linear (Frequency domain) Methods and Non-Linear (Poincare Plot) Methods. Classification is done to identify the type of disease using KNN,SVM, Decision Trees and Deep Learning techniques.

K-Nearest Neighbour(KNN) : KNN is a classifier which identifies the class of an unknown instance based on the majority voting of its nearest neighbors. The instances are categorized into disjoint sets based on the assumption that instances of feature vector that are near each other in feature space represent instances that belong to the same class. The nearest neighbors of the unknown instance are decided on the basis of Euclidean Distance formula.

Support Vector Machine : In this classifier, the instances are separated into disjoint classes in feature space using a hyper- plane that maximizes the margin between two classes.

Deep Learning: Deep Learning is considered as the learning of hierarchical feature representation. It depend on human domain knowledge more than on the available data. The design is independent from the system's training. The turning is difficult when the number of parameters in the system is large. The classification accuracy is studied using Overall Classification Accuracy (OCA) and Sensitivity as defined in equation (1) and (2).

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN} \quad \text{…….. (1)}$$

$$\textit{Sensitivity} = \frac{\textit{True Positives}}{\textit{True Positives} + \textit{False Negatives}} \quad \text{……(2)}$$

RESULTS AND DISCUSSION

Mangroves are classified into various categories with the classification algorithms such as KNN, SVM and Deep learning as shown in fig. 2 and fig.3 and fig. 4 shows a portion of tree having branch crankers and the classification accuracy has shown KNN producing better results than other methods as in Fig. 5 and Fig. 6.

Fig.2 Group of Trees identified as Mangrove

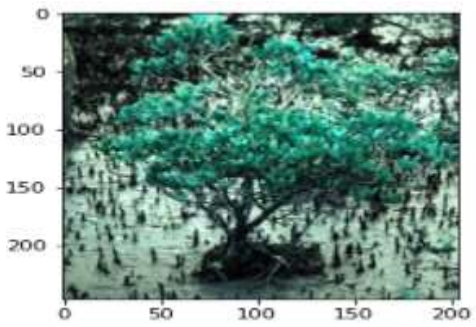

Fig.3 Separate tree identified as Mangrove

Fig.4 Branch Crankers

	precision	recall	f1-score	support
Red	0.46	0.43	0.45	30
Yellow	0.40	0.50	0.44	16
green	0.45	0.42	0.43	24
accuracy			0.44	70
macro avg	0.44	0.45	0.44	70
weighted avg	0.45	0.44	0.44	70

Fig.5 Classification Accuracy

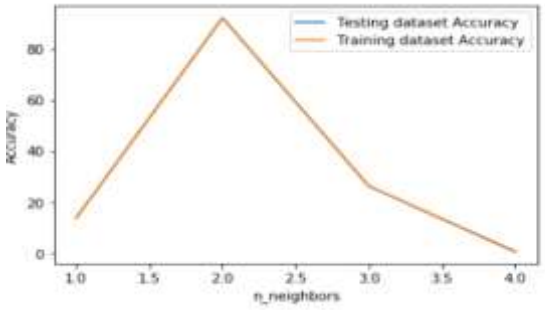

Fig.6 Classification Accuracy of KNN

CONCLUSION

Trees can be differentiated by their varying structure with attributes such as Species, dbh (Tree diameter at breast height) in crow, height, aerial root, leaves, etc. From the classification of trees, trees which are rotten or infected can be identified and preserved from further deterioration. In this paper, we have classified using classification techniques like KNN,SVM and Deep Learning. Once classified they are further processed to check damages if any based on their morphological features. It is found that KNN having better accuracy compared to the other methods.

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