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Research Article

An Analytical Review on Plant Leaf Disease Classification in Agriculture Area

Richa Gupta
Department of Computer Science & Information Technology, Graphic Era Hill University, Dehradun Uttarakhand India 248002

Abstract
In this procedure, we suggest that plant disease detection systems use imaging technology to automatically recognise the signs of a plant's ailments on its leaves and stem, assisting in the cultivation of healthy plants in a farm. These devices keep an eye on the plant's leaves and stem, and any alteration seen in its distinguishing characteristics will be automatically detected and also reported to the user. The disease detection techniques that are currently used in plants are evaluated in this work. Plant disease research focuses on a specific plant's visually discernible patterns. In order to successfully cultivate crops, it is determined that identifying plants, leaves, and stems as well as determining the presence of pests, illnesses, or their proportion are all extremely important. The method that many farmers use to find and identify plant diseases is simple observation with the unaided eye. On vast farms, it is less practical and necessitates constant observation. Additionally, non-native illnesses are unknown to the farmers. The primary goals of this research are to pinpoint the area that is afflicted, identify the disease that is present, and enhance classification performance by increasing segmentation accuracy.
Keywords: Plant Disease, Agriculture Environment, Healthy Plants, Plant Disease Detection and Classification, discernible patterns.

1. Introduction

Because there are so many plant species in the globe, it can be difficult and time-consuming to identify them, especially for non-expert stakeholders like land managers, foresters, agronomists, amateur gardeners, etc. Therefore, an automated plant identification tool ought to make the work of identifying plant species quicker. Even expert botanists may find use for this identifying tool. Predicated upon the examination of the plant's internal structures, including the buds, leaves, fruits, stems, etc., a plant may be identified. In this study, we concentrate on leaf morphology and shape-based methods for leaf recognition. One can create a unique method or modify a general shape retrieval technique to the specific situation of leaves to characterise the form of a leaf.

This essay provides a summary of the ReVeS project's involvement in the 2012 Image CLEF Plant Identification challenge. Our approach, which aims to build a programme for identifying tree leaves on mobile platforms, is made to deal with the difficulties presented by complex nature photos and thus to facilitate pedagogic contact with the user. The method is based on a two-step model-driven segmentation, assessment of high-level properties that allow for a semantic interpretation, and evaluation of more general shape aspects. A random forest classification technique is used to aggregate all of these characteristics, and their importance is assessed. Our team came in third on natural photos and fourth overall, which is a very pleasing achievement in light of the project's goals.

Nowadays, only professionals have access to the capacity to identify a plant species and comprehend its unique characteristics. The majority of botanical books warn eager beginners who lack the necessary academic grounding that they are in for a difficult time. However, mobile platforms give users the chance to interact with this knowledge in a personalised way. With remarkable success, mobile plant species identification aids have already been developed for photographs with a white backdrop. The ReVeS project seeks to develop a system that will assist users in learning how to identify a tree in a natural setting from a snapshot of a leaf.

Understanding the image begins with locating the leaf contour, which is a critical initial step. It is an extremely difficult problem in unsupervised, complex, natural pictures where it is vital to make the most of the information available to make the process easier. To lower the possibility of errors, it is a good idea to include prior information of the anticipated shape of the item we are searching for. However, in the case of a mobile application, not using a human user to manage an automated procedure that might alternatively be especially susceptible to irrational behaviour would be unsatisfactory.

The most pertinent information to depend on when attempting to approximate the shape of a leaf in possibly poor photos appears to be colour. Given the variability caused by season, species, and lighting, it is hard to create a reliable a priori colour model for all leaves; nonetheless, from each image, a colour model will be extracted., for this purpose we begin with establishing a reasonable understanding of where the leaf is in the image. When dealing with real photos, what is relatively straightforward to solve on white backdrop photographs—where finding the leaf only requires a simple thresholding of the grey-level image—becomes considerably more difficult. At this point, we need the user's help to create a region inside the leaf, a region that, in the event of a complex leaf, must have at least three components. In order to align with our frame of work for a mobile application, we additionally rotated and cropped certain images so that they obviously only include one leaf that is of importance, with its apex pointing roughly to the top of the image. The only human interaction in the identification process is this, and it only applies to photographs.

We attempt to estimate a model of the leaf's colour based on this first, initial area, and to calculate the distance of each pixel to this model. This is accomplished by combining, on the basis of evidence, the dissimilarity to a global colour model calculated by linear regression on the beginning region and the dissimilarity to a local adaptive model developed by modifying an anticipated mean colour while examining the image. To take the specifics of two pertinent yet different sources of information, the application of belief function theory [6, 18] is in this case more effective than simpler combinations (mean, minimum).

2. Literature Survey

The method for enhancing classification performance for classes with few training examples is suggested in this research. Finding courses that are comparable and sharing information amongst them is the main concept. The classes are arranged using our technique into a tree hierarchy, which may be used in conjunction with discriminative models like deep neural networks. Using fixed trees, we demonstrate how the model may transfer information between related classes. One is that we demonstrate our method outperforms existing methods, most of which integrate saliency maps built heuristically from several sorts of input, by integrating the regional contrast, regional property, and regional backgroundness descriptors to build the master saliency map. The foundation of this essay is the notion that the built-in structure of the collection of classes may be used to enhance performance. For instance, we are aware of the relationships between cheetahs and tigers, lions, jaguars, and leopards. The process of learning from 5 instances of cheetahs should be made considerably simpler by the labelled examples from these linked classes. Knowing how classes are organised should enable us to borrow information from pertinent classes, requiring us to learn just the particular characteristics unique to cheetahs. A hierarchical multi-task structure learning system is created in this study to facilitate the identification of numerous plant species on a big scale.

A collection of sister categories of plant species or sibling fine-grained plant species are present for a specific parent node on the visual tree for that parent. We need to develop an effective model for each class in order to identify which ones are connected. An ongoing dependence results from this. It may be worked around by manually defining the class structure using an external knowledge source, such as a person [1].

In this research, 35 cutting-edge saliency detection algorithms are quantitatively compared. We discover that certain models regularly outperform the rest. Finding courses that are comparable and sharing information amongst them is the main concept. We determine the scenarios where models or humans fail to recognise the most prominent item by examining the consistency between the best models and among humans for each scene. The foundation of this essay is the notion that the built-in structure of the collection of classes may be used to enhance performance. In order to facilitate widespread plant species identification, a hierarchical multi-task structure learning method is created in this study. On the visual tree, each parent node has a collection of categories of plant species or sibling fine-grained plant species. We require a solid model for each class in order to identify which ones are connected. The result is a cyclical dependence. When compared to computer models, humans are poor in object detection [2].

The foundation of this essay is the notion that the built-in structure of the collection of classes may be used to enhance performance. Finding courses that are comparable and sharing information amongst them is the main concept. Our approach may be used with Gaussian Processes, Support Vector Estimation, Regression, and any other regularised risk reduction scenario that generates a convex optimization issue. Knowing how classes are organised should enable us to borrow information from pertinent classes, requiring us to learn just the particular characteristics unique to cheetahs. A hierarchical multi-task structure learning system is created in this study to

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facilitate the identification of numerous plant species on a big scale. It comprises a group of plant species categories or sister fine-grained plant species for a certain parent node on the visual tree. We require an effecient model for each class in order to identify which classes are connected. This results in a cyclical reliance, which may be avoided by manually defining the class structure using an external knowledge source, such as a person. An object's saliency is low to humans but high to computer models. Some models utilise distinct detection strategies, according on an analysis of model similarities [3].

The authors of this work provide a unique probabilistic method for determining a label tree's parameters. The approach combines classification with tree traversal to enable logarithmic complexity growth. The foundation of this essay is the notion that the built-in structure of the collection of classes may be used to enhance performance. Knowing how classes are organised should enable us to borrow information from pertinent classes, requiring us to learn just the particular characteristics unique to cheetahs. A hierarchical multi-task structure learning system is created in this study to facilitate the identification of numerous plant species on a big scale. It comprises a group of plant species categories or sister fine-grained plant species for a certain parent node on the visual tree. A plant picture, for instance, must be appropriately designated to a parent node (high-level non-leaf node) before it can be placed in the appropriate location, according to the inter-level relationship requirement. An object's saliency is low to humans but high to computer models. Some models utilise distinct detection strategies, according on an analysis of model similarities [4].

The foundation of this essay is the notion that the built-in structure of the collection of classes may be used to enhance performance. For instance, we are aware of the relationships between cheetahs and tigers, lions, jaguars, and leopards. For very complex multi-class problems like online advertising, document categorization, and picture annotation, our technology enables real-time inference. Knowing how classes are organised should enable us to borrow information from pertinent classes, requiring us to learn just the particular characteristics unique to cheetahs. A hierarchical multi-task structure learning system is created in this study to facilitate the identification of numerous plant species on a big scale. It comprises a group of plant species categories or sister fine-grained plant species for a certain parent node on the visual tree. A plant picture, for instance, must be appropriately assigned to a parent node (high-level non-leaf node) before it can be placed in the appropriate location, according to the inter-level relationship requirement. Although it is high for the models, gradient descent in the primordial with a line search to select the ideal step size is low for humans. Some models employ various saliency detecting strategies, according on an analysis of model similarities. The best approach we have found for ImageNet and Product Images has a speedup of 85 or 142 when embedding and label tree learning are combined [5].

3. Proposed System

Finding an appropriate contour is a difficult and important component of the procedure of identifying trees from images of leaves against a natural backdrop. For basic and lobed tree leaves, we provide an approach in this procedure that is intended to overcome the challenges presented by such complex pictures. First, a segmentation stage predicated on a light polygonal leaf paradigm is carried out, followed by thresholding, employing techniques like k-means clustering. We combine global shape descriptors to extract features, such as GLCM features, and then classify the leaves using the multi-SVM classifier technique.

There are several segmentation techniques available today, making it challenging to select the best one for a given application. Additionally, tweaking their settings might be quite difficult. Some writers suggested including pre-processing stages within the segmentation pipeline to provide better results. In this regard, Weber et al. suggested a number of publications, emphasising one that highlights a segmentation method based on quasiflat zones.

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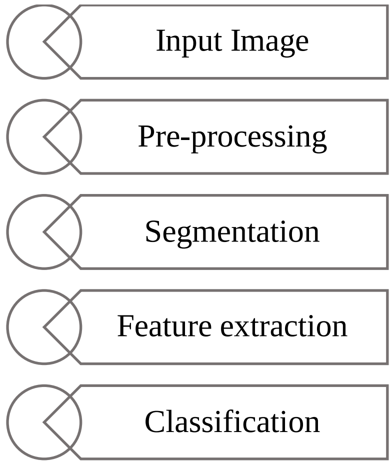

Fig 1: Framework for the System

The innovation is in the user-guided application of segmentation using morphological techniques on a previously processed picture (i.e. an over-segmentation of the image in quasi-flat zones). Benefits of the suggested strategy include the following:

- In comparison to the current approach, the procedure is more accurate.
- Due to the small number of datasets utilised, process dependability is at its highest level.

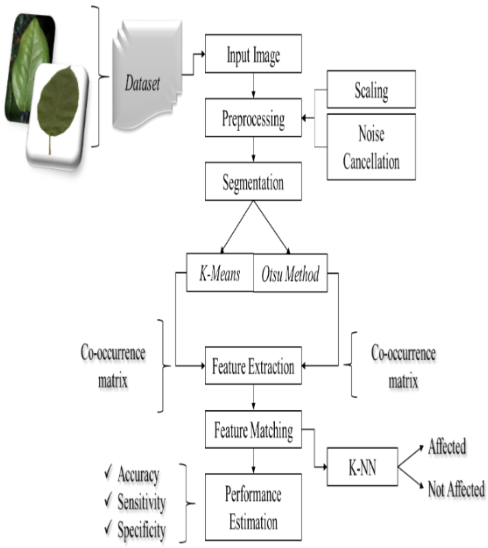

Fig 2: Flow Diagram

Various phases that are involved during implementation of proposed approach are explained under following section:

1. Preprocessing

The technique of reducing noise from a picture is known as noise reduction. Analog and digital recording equipment alike have characteristics that make noise intrusion a possibility. It is possible for noise to be random, white noise that lacks coherence, or coherent noise that is brought on by the mechanism or processing algorithms of the device. Hiss is a common type of noise in electronic recording equipment brought on by haphazard electrons that deviate from their intended route under the strong impact of heat. These errant electrons alter the output signal's voltage and produce audible noise as a result.

2. Segmentation

Masking and threshold-based segmentation are the first and second steps in the segmentation process, respectively. Pixel masking refers to setting a pixel's value in a picture to zero or another value. The healthy area

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of the plant's leaves is indicated by the colour green, thus it is best to avoid green areas when looking for unhealthy areas. A threshold-based algorithm will select an appropriate threshold value T to categorise the pixels in a picture into different groups.

3. Feature extraction

The effective feature extraction approach is principal component analysis. It extracts the topography of the image's characteristics, which provides the specifics of the sign forms. In order to find interest areas (main aspects) that are covariant to a class of transformations, the fundamental concept is to first find such regions. Quantifying a region's texture content is a crucial step in the region description process. Measures of characteristics including smoothness, coarseness, and regularity are provided by the texture descriptor.

4. Classification

An algorithm known as a classifier uses the object description to determine the class to which a given item belongs. When a majority of an item's neighbours agree on a classification, the object is put into the category that is most popular among its k closest neighbours. In order to classify and predict outcomes in pattern recognition, the k-NN algorithm uses non-parametric methods.

4. Results

This project's main goals are to pinpoint the area that is afflicted, determine the illness kind that is present, increase segmentation accuracy, and enhance classification performance. In this procedure, we suggest that plant disease detection systems use imaging technology to automatically identify problems on a plant's leaves and stem. This aids in growing healthy plants in a farm. These systems keep an eye on the plant's leaves and stem, and they automatically identify and notify the user of any variations seen in the plant's identifying characteristics. Image processing is a technology that enhances all already conducted research and provides quick and accurate results for plant disease. The following screenshots demonstrate how to recognise common plant diseases.

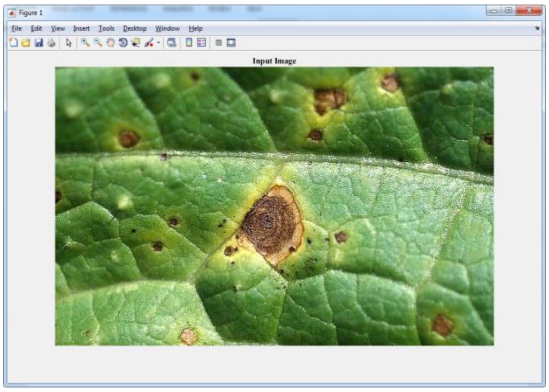

Fig 3: Input Image

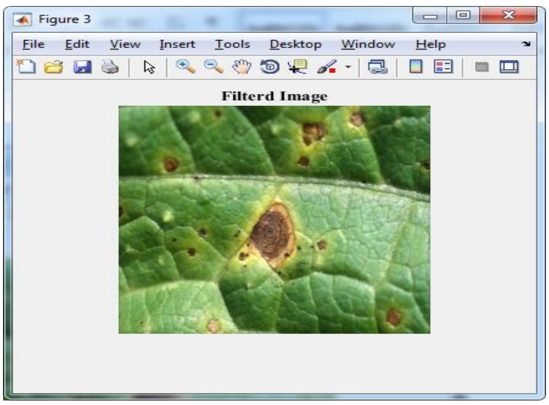

Fig 4: Filtered Image

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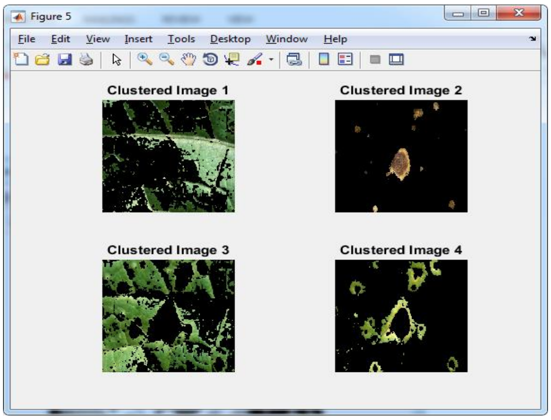

Fig 5: Clustered Image

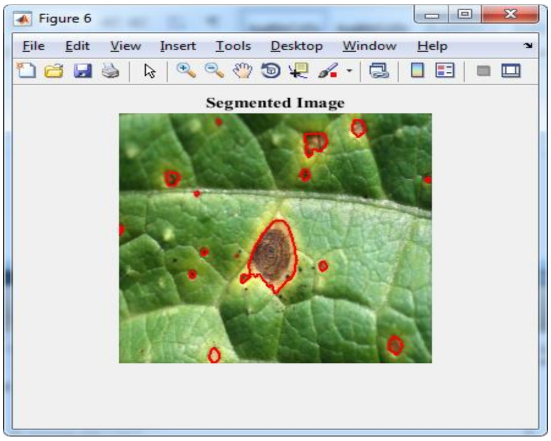

Fig 6: Segmented Image

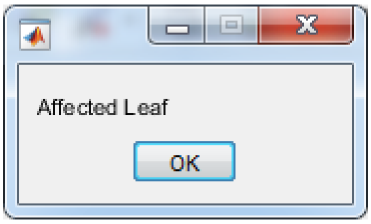

Fig 7: Result Analysis

5. Conclusion

The primary goal of this strategy is to identify illnesses on various plant species in agricultural settings where speed and accuracy are crucial elements in disease diagnosis. Therefore, the development of sophisticated algorithms for quick and precise disease identification of leaves will be the main emphasis of this work's extension. After going over all of the strategies and procedures discussed above, it is clear that there are several ways to identify plant diseases. Each has drawbacks as well as some positives. As a result, the current research has room for improvement. Image processing is a method that advances all previous research on plant diseases and provides quick, reliable results.

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