Comparative Analysis of State-of-Art Models for Agricultural Image Processing

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Abstract:

Agricultural image processing has emerged as one of the most inventive and essential image processing fields in recent years. It is currently attracting the attention of academics due to the wide range of connected subdomains. The examination of many domains linked with agricultural image processing is defined in this paper. The recognition model was also examined from a broader perspective in the research. A broad framework for plant disease classification and recognition was proposed in this research. SVM, Neural Network, K-Means, and PCA are just a few of the efficient classification algorithms studied in the research.

Keywords: Agricultural, Plant, Leaf, Land Featured set

1. Introduction

Image processing is becoming increasingly important in a variety of fields. Agricultural image processing is one of the fastest-growing areas of image processing. This processing field is a huge application area with a broad scope defined by several processing methodologies. Figure 1 depicts some of the most effective agricultural image processing sectors. The division of agricultural image processing is done under the application specification, as indicated in the diagram.

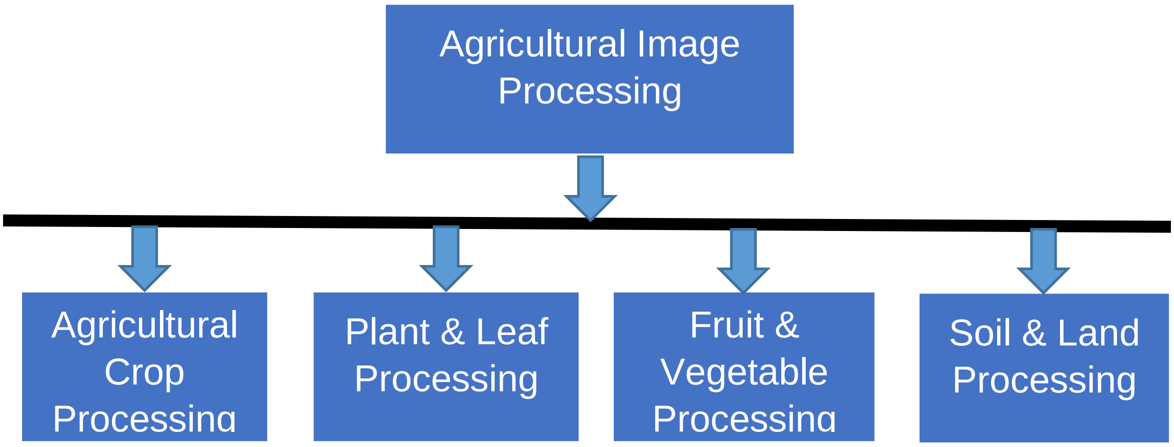

Figure 1 Agricultural Image Processing

Agricultural image processing is divided into four key application areas: image processing related to crops, Processing of plants and leafs, processing related to fruits and vegetable section, and processing of land and soil. All of these areas of application are further subdivided into different unified sub-areas. These sub-areas are established by the utility specifications for the application areas. These utilities are detailed in detail in this section in relation to the application areas.

1.1. Agricultural Crop Processing

Agriculture is primarily characterized in terms of crops, and there is a wide range of crops to choose from. The initial application in merging these crops with image processing is to detect and classify them. This classification can be used to distinguish between particular crops and crop categories. Agricultural disease identification is another sub-area of crop processing. The identification of pests and other diseases is one of these diseases. The availability of a large number of crops is the main problem in crop image processing. Because some of these crops have very similar feature specifications, identifying the crop and the illness that affects it is challenging. Similarly, in terms of photographs, there is a scarcity of knowledge about a certain crop disease. There are only a few diseases that can be distinguished by their apparent symptoms.

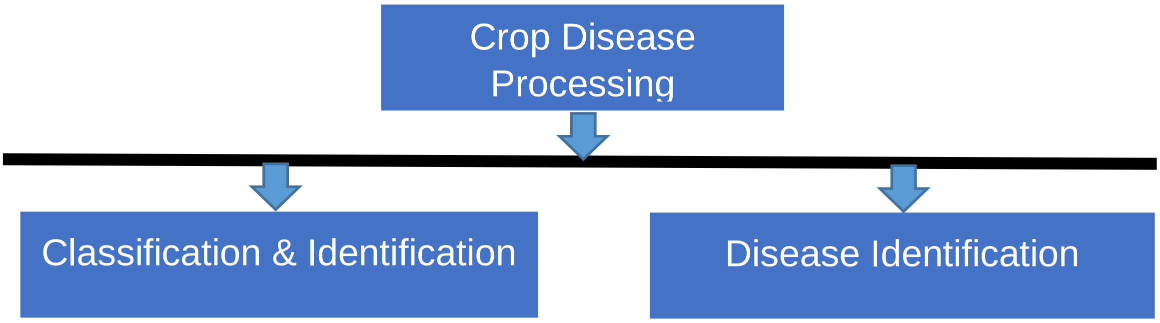

Figure 2 Crop Image Processing

1.2. Image Processing of Plant and Leaf

Plant and leaf images are another key application area for in the field of image processing related to agriculture. This is yet another large area of the domain which is used to distinguish between different types of plants or trees. These plants or trees include flowering plants, vegetable plants, and fruit trees identification. Different parts of the plant can be used to identify class. The leaf, blossom, root, and stem are among these components. Analysis of the leaf's form, dimension, and structure falls into this category. This application area also involves the classification and identification of plants and trees, both individually and in groups. The detection of disease on the basis of the plant leaf, as well as subcolor and feature identification, is another subdomain of plant processing. Figure 3 depicts related areas of application that fall under plant and leaf processing.

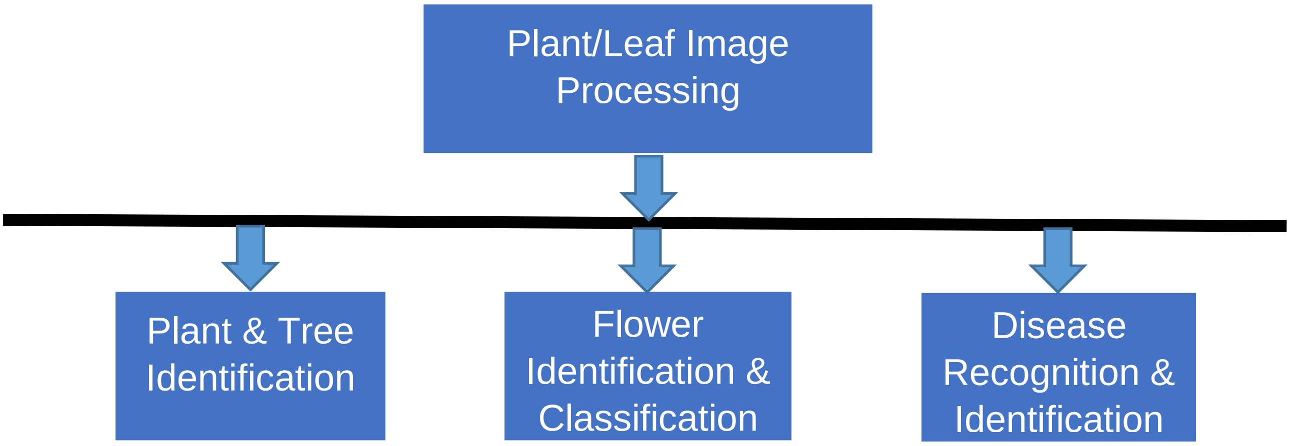

Figure 3 Plant/ Leaf Image Processing

1.3. Fruits and Vegetable Processing

Fruit and vegetable image processing is another key application area in agriculture image processing. There are two primary sides of plants in this area. First, identify the specific fruits and vegetables, and then, if necessary, identify any linked diseases. The identification of the object as well as the sickness will be carried out.

1.4. Processing of Soil for Agriculture

The application in this area covers two key sub-areas: processing of region on the basis of soil type and SAR image identification. The images retrieved from the satellite are known as SAR images. This method is in general used for the classification of the geographical locations on the basis of the respective land and the soil features, as well as region analysis. This is a difficult application area that necessitates more intelligence processing in order to identify the locations. The exploration of the classification process is analyzed in detail in this study. The investigation related to several classification approaches is included in the paper. The study related to the classification of image, as well as the major group of the classification process, are reviewed in the current section. The review associated with the domain is discussed in section II. The plant detection and classification model is discussed in Section III. Different picture categorization techniques are discussed in section IV. The conclusion reached as a result of the work is stated in section V.

2. EXISTING WORK

The work of earlier scholars in the field of picture categorization is addressed and discussed in this part. Object identification, recognition, and illness prediction over images are all part of these processing fields. This section contains few of the available literatures.

Parveiz Zeaiean[1] has defined a work based on supervised learning in order to diagnose and estimate crop disease. To determine the classification of crop, the author employed crop identification based on the estimation of crop region identification. Based on the calculation of the crop size and area, the author proposed a maximum likelihood approach for parallel processing to identify the effective object area. The author defined the method for determining the crop as well as the relative class.

Wilbert Long[2] has established a work to analyse the land area based on soil identification. The satellite photos are taken, and region categorization and segmentation are performed. The author identified the locations using the land area estimating rules and structural information extraction. With the formulation of supervised learning with class identification and area formation, the author established a parameter driven learning approach. The author described a method for determining the relative class using remote sensing to identify a specific land region.

Jinguo Yuan[3] has specified a work on land image processing in order to determine the relative regions when SAR image processing is used. This type of processing is also defined in terms of obtaining correct region generation and determining the region class in the context of a features analysis. The author employed a PCA-based approach to assess biographic elements so that image areas could be identified. To identify the relative regions, the author defined the learning strategy under multi scale segmentation.

Y.Lanthier[4] has specified a study on SAR image classification and segmentation to acquire land regions under the specification of soil reformation. This type of segmentation is carried out using pixel-level analysis in conjunction with region specification and identification. The computational approach used by the author to establish the clusters and cluster members used to generate the individual regions was defined such that the size, shape, and colour of these useful image portions could be formed efficiently.

Heather McNairn[5] developed a method for crop classification and segmentation based on the polarisation of the effective picture areas. This type of area segmentation involves crop classification, which includes the specification of various crop capabilities, as well as the classification of image areas. This specification comprises the determination of intensity as well as the examination of relative diversity in order to produce an accurate crop categorization. A paper on plant disease identification using a neural network approach was presented by Haiguang Wang[6].

To identify diverse plant diseases, Haiguang Wang[7] developed a hybrid technique that combines PCA and neural networks. To define the dimension analysis utilising the PCA approach, the author created a feature analysis-based study. This method entails accurate disease identification as well as disease prediction based on colour and other attributes analysis.

Nurul Hidayah Tuhid[8] proposed a statistical analysis-based approach for identifying and detecting orchid illness based on colour model analysis applied to a picture. Color feature analysis is used to identify the orchid. This disease resembles an infection, and disease analysis is performed over the image. The disease categorization was created by the author based on image segmentation and capture image evaluation under various parameters.

Sanjeev S Sannakki[9] proposed a neural network-based approach to disease identification and categorization. Under the intelligent system, the author defined the diagnostic strategy for identifying the ailment. The author has worked on the grape plant in particular. There are two primary stages to the proposed system. The first stage involves identifying the object in the photograph. The segmentation approach is defined to conduct this object detection. The masking of the image can be done in the second stage under the disease prediction. The author uses the KMeans clustering approach to discover and classify the disease.

Asma Akhtar[10] gave a talk about disease detection and prediction. Under pattern analysis, the author defined a machine learning approach for detecting and predicting plant diseases. To detect the illness zones over the image, the author created a three-phase framework. The author characterised the task as identifying features across the image in order to develop effective regions for feature extraction and selection.

Lung-Jen Wang [11] created a system for improving picture characteristics in order to perform effective image classification. The work of the author was defined as a preprocessing strategy to improve image effectiveness and feature analysis and improvement.

In [12], the author explored thermal imaging and its applications in agriculture. Thermal imaging is a passive approach that focuses on water (infrared range 3 to 14 m). Water can be used as an important parameter in pre-harvesting operations since it affects the thermal properties of the plant and each leaf has a varied amount of water per area. Thermal imaging applications in field nursery, irrigation scheduling, yield forecasting, and green house termite assault were discussed. Operations such as ripeness evaluation, bruise detection, and detection of foreign compounds in food were also examined after harvesting. Thermal imaging offers superior findings, but it is not universally accepted in agriculture applications since plant physiology and environmental circumstances vary by region.

X-ray imaging was highly ideal for luggage inspection of illegal food products, packaged food, specifically bottle or can packed. Natsuko Toyofuku [13] and Ronald P. Haff proposed an X-ray imaging technique for detecting faults and contamination in food. The contrast in X-ray images of packaged food (metal, plastic, glass, etc.) is significantly higher than the typical faults or pollutants of interest observed in fresh fruit (insect infestation, physiological defects, etc). Other sectors where X-ray imaging can be used include poultry inspection for bone fragments and thickness identification, and wheat grain examination. Detection of illness on apples, bug detection in tree nuts, and food grading were only a few other X-ray imaging applications with the drawback of slow examination speeds. X-ray imaging with classifiers has also been shown to be effective sorters in food grading [14].

3. CLASSIFICATION APPROACHES

An examination of some of the most effective classification systems is discussed in this section.

3.1.SVM

SVM is one of the most useful learning algorithms and is often used as a substitute for neural networks. This algorithmic technique is based on examining the expected error minimization and analysing specific properties. This method took into account the empirical risk in order to improve the training procedure. The risk estimation is based on structural analysis in order to minimise the generalisation error. Under class deviation, the error margin is assessed, and the nearest training patterns are determined based on it. SVM is useful for evaluating separating planes and determining the biggest margin so that the data points' support may be determined. This model is indeed based on the polynomial kernel representation, which allows for more effective learning of the elements and higher accuracy.

3.2. Neural Network

The neural network is based on the biological nervous system and describes the human brain's process. The structural construction and analysis of intelligent interconnected processing is the main method. ANN will be set up as an application procedure, allowing for effective pattern identification based on the learning process. The neural network can extract information from both complex and imprecise data, resulting in trained information patterns. The pattern generation and extraction will be conducted as the signal characteristics by this classifier, which is built on several layers. These patterns may be used to identify the best features, which can then be used to train and verify the network using spectral feature analysis, resulting in effective recognition.

3.4. K Means Clustering

KMeans clustering is a straightforward classification approach in which the dataset's classes are predetermined. Each class is represented as a cluster, and the cluster centres are believed to be distributed across the dataset. The distance analysis is carried out after the classes have been defined. The bounds to each cluster class are defined as a threshold limit. The particles that are subjected to these distance estimations in relation to a specific class now identify the members of that class.

3.5. Principle Component Analysis

PCA is a statistical method that uses image pixels to do a distance analysis on contiguous bands. It is capable of detecting the object's highly connected data collection. This technique entails transforming the original data in order to determine the correlation between distinct bands. This procedure also comprises a linear combination of band level analysis in order to acquire the variation in pixel values. The correlation analysis is performed using the PCA approach, which is based on the statistic property used under hyper spectral bands defined under dependence vector. This type of analysis can be performed using a transformation vector to get an effective information transformation based on mathematical principles.

Author	Process	Advantage	Limitation
Parveiz Zeaiean[1]	Statistical measures were used to define a work on crop classification. The neighbourhood analysis at the region level is defined here for the analysis.	It is termed a work based on maximum likelihood analysis. The recognition procedure and efficiency have improved thanks to the statistical parallel processing work.	The task becomes more complex as a result of parallel processing, and there is less class differentiation in this work.
Wilbert Long[2]	To identify the soil regions, a land area based image analysis task has been defined. The rule structural technique is used to define classification and segmentation. The learning algorithm is used to accomplish region classification	The rule-based classification method provides improved classification and clearly defined regions. The classification procedure has been improved thanks to the structural analysis.	This work defines a smaller number of class divisions.
Jinguo Yuan[3]	Work on SAR image processing utilising correlation analysis was defined by the author. The hyperion processing yielded precise feature extraction, which was then processed using the PCA technique for region categorization.	The multiscale region processing has appropriately separated the area into numerous regions. The use of both cognitive and statistical methods has improved efficiency and accuracy.	The curvic separation of regions remains a prerequisite of the project. The precision could be increased.
Y.Lanthier[4]	Under clustering and classification techniques, the author defined work on region separation and segmentation. Clustering is done using physical and pixel intensity data, and the effective region separation	The soil-based feature extraction approach can divide the territory into different pieces. Because the segmentation procedure is based on the clustering method, better	A curve separation technique is necessary to produce a more accurate classification.

	over the area is calculated.	results are expected across the region.	
Heather McNairn[5]	To extract the crop feature and perform region classification, an image diversity and intensity analysis approach is defined. The polarisation method is used to segment the regions here.	Crop classification is defined here using a learning approach. The classification procedure has been enhanced thanks to the work.	The work require more accurate decision.
Haiguang Wang[6]	The author defined a neural network-based work for identifying plant diseases. To create the regression network and execute the plant disease classification, the author employed the back propagation approach with the radial basis function.	The approximation on the basis of probabilistic approach for the classification of the disease has improved accuracy. In order to improve the recognition rate, analysis of rust and wheat analysis is introduced.	The classification approach need to be tuned further for improvement.
Haiguang Wang[7]	For plant feature extraction and disease prediction, the author defined a neural integrated PCA technique. For the classification and recognition procedure, the author has defined a dimension-specific PCA technique.	The recognition rate has improved thanks to the clever system. The efficiency and accuracy of the hybrid recognition procedure has improved.	The accuracy is improved.
Nurul Hidayah Tuhid[8]	The author defined a statistical analysis approach for orchid disease classification. To increase recognition, the author employed colour feature	The statistical method resulted in more precise decisions.	The work based on multiple feature analysis was necessary to improve the recognition process' efficiency.

	extraction. For accuracy, the segmentation effective strategy is defined.		
Sanjeev S Sannakki[9]	To perform disease categorization, the author created a layered model utilising a neural network approach. To anticipate the disease, the K Means method is used as a clustering approach, and the neural network is used as a classification algorithm.	Work has raised the rate of recognition, and it has produced effective results.	To categorise, the neural network approach needs be enhanced.

4. CONCLUSION

The recognition and classification of plant/leaf diseases is defined in depth and in a larger sense in this publication. The work has investigated agricultural image processing as well as related application areas, and has established a larger model to perform effective image recognition. A examination of some of the existing classification systems is also defined in the report.

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