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Real Time Identification Of Crops, Weeds, Diseases, Pest Damage and Nutrient Deficiency

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Abstract
Agro consultant application deals with crop's name, weed, pest damage, disease and nutrient deficiency analysis using image processing techniques for automated vision system used at agricultural field. The proposed decision making system utilizes image content characterization and supervised classifier type of neural network .Image processing techniques for this kind of decision analysis involves preprocessing, feature extraction and classification stage. At Processing, an input image will be resized and region of interest selection performed if needed. Here, color and texture features are extracted from an input for network training and classification. Color features like mean, standard deviation of HSV color space and texture features like energy, contrast, homogeneity and correlation. The system will be used to classify the test images automatically to decide leaf characteristics. For this approach, automatic classifier NN be used for classification based on learning with some training samples of that some category. This network uses tangent sigmoid function as kernel function. Finally, the simulated result shows that used network classifier provides minimum error during training and better accuracy in classification.

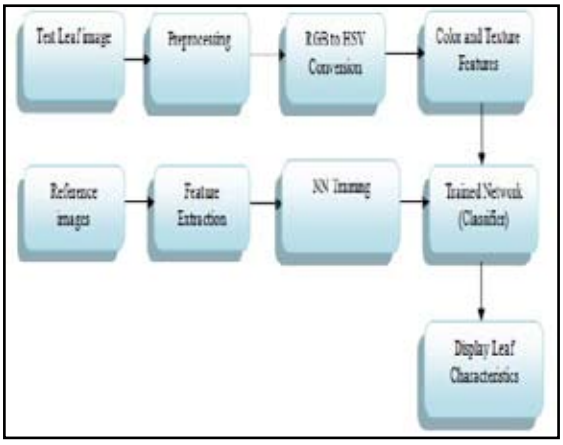
Keywords
Image processing, HSV, Pre-processing, homogeneity and correlation.

I. Introduction

In agriculture research of automatic leaf characteristics detection is essential one in monitoring large fields of crops, and thus automatically detects symptoms of leaf characteristics as soon as they appear on plant leaves. Agricultural research remains a central concern of the developing countries. In India Agriculture contributes around 26 % to the total GDP. It provides livelihood to about 65 % of the labor force and accounts for 8.56% of India's exports. So it is essential to improve the yield and increase productivity by eradicating weeds damage, pest damage and nutrient deficiency. New technologies, inputs and technique reduce the workload of farmers. Agro Consultant looks for unique ways to increase productivity in efficient manner possible.

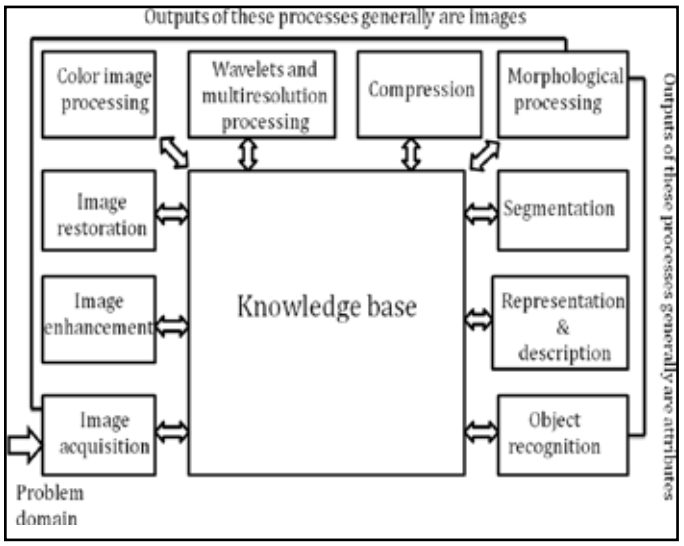
II. Proposed System

The proposed decision making system utilizes image content characterization and supervised classifier type of neural network .The user's input image will be fed into the system. The image will be pre-processed where the color, texture and the shape features are extracted. Then a neural network is formed between the input image and the images in the data set. Here K-means clustering algorithm is used which provides better accuracy in finding crop name, weed, pest, diseases and nutrient deficiency.



III. Image Processing

Digital image processing, the manipulation of images by computer, is relatively recent development in terms of man's ancient fascination with visual stimuli. In its short history, it has been applied to practically every type of images with varying degree of success. The inherent subjective appeal of pictorial displays attracts perhaps a disproportionate amount of attention from the scientists and also from the layman. Digital image processing like other glamour fields, suffers from myths, mis-connections, mis-understanding and mis-information. It is vast umbrella under which fall diverse aspect of optics, electronics, mathematics, photography graphics and computer technology. Several factor combine to indicate a lively future for digital image processing. A major factor is the declining cost of computer equipment. Several new technological trends promise to further promote digital image processing. These include parallel processing mode practical by low cost microprocessors, and the use of charge coupled devices (CCDs) for digitizing, storage during processing and display and large low cost of image storage arrays.



IV. Module Implementation

A. Crop Identification

As the name suggests, the module identifies any given crop under question. Machine learning and image processing is used to sift images through the database. Required information is displayed as output. User gives a digital image of the crop under question as an input. Measurement of the pattern and the image recognition is completed. After the classification of output and assessing the accuracy report is generated. Output is displayed, which consists of the botanical family name of the crop and the common name of the crop.

B. Major and Minor Disease Identification

As the name suggests, the module supports in identifying the disease in a crop. Information on preventing the disease in the next cropping season is provided. Machine learning and image processing is used to recognize the disease. A Snap of the infected crop is taken by the user. Measurement of the pattern and the image recognition is completed. After recognition, the output is displayed which consists of the name of the disease, diagnosis steps to mitigate the disease and biological treatment of the disease. Also, the uploaded image is geo-referenced and time- referenced and added to database.

C. Pest Identification

As the name suggests, the module supports in identifying the pest in a crop. Machine learning and image processing is used to recognize the pest. Information on preventing the pest in the next cropping season is provided. User takes a digital image of the pest damaged crop. Measurement of the pattern and the image recognition is completed. After recognition, the output is displayed, which consists of the unwanted funguses and insects recognized, diagnosis step to mitigate and right pesticide treatment is provided. Also, the uploaded image is geo-referenced, and time referenced and added to database.

D. Weed Identification

This module supports in identifying weed from the crop. Machine learning and image processing is used to sift images through the database. Full description and information is provided. The digital image of the weed under question is taken by the user. Once the image recognition and the measurement of pattern is done, the following results are displayed which consists of the common name of the weed species and the scientific name of the weed species.

E. Nutrient Deficiency Identification

As the name suggests, the module supports in identifying the nutrient deficiency in the crop. Machine learning and image processing is used to recognize the nutrient deficiency. Information on nourishing the crop in the next cropping season is provided. User takes a digital image of nutrient deficient crop. Measurement of the pattern and the image recognition is completed. After recognition, the output is displayed, which consists of the new growth and old growth stages of deficiency, analysis of major and Minor deficiency, essential nutrients and the guide to curb the deficiency. Also, the uploaded image is geo-referenced, and time referenced and added to database.

V. Methodologies

All the above five modules viz, crop identification, disease identification, pest identification, weed identification and nutrient deficiency identification follows the same methodologies.

- Image segmentation
- Image preprocessing
- Color Space Conversion
- Texture Features Extraction
- Shape feature extraction
- NN classifier

A. Image Segmentation

Segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

B. Image Pre-Processing

Image pre-processing can significantly increase the reliability of an optical inspection. Several filter operations which intensify or reduce certain image details enable an easier or faster evaluation. Users are able to optimize a camera image with just a few clicks. Image pre-processing has the following sub steps which are,

1. Color Space Conversion

HSV (Hue Saturation Value) algorithm is used for identifying the color of the image.HSV converts RGB values to the appropriate hue, saturation, and value (HSV) co-ordinates. Here the RGB image is converted into gray scale where each pixel will only have the intensity value. A binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white though any two colors can be used. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color. A grayscale Image is digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray(0-255), varying from black(0) at the weakest intensity to white(255) at the strongest.

2. Texture Feature

GLCM (Gray Level Co-occurrence Matrix) algorithm is used for finding the texture of the plant. The GLCM values are stored in a 3x3 i x j x n matrix, where n indicates the number of GLCMs calculated usually due to the different orientation and displacements used in the algorithm. `Graycomatrix` calculates the GLCM from the scaled version of the image. If `I` is a binary image, `graycomatrix` scales the image to two gray-levels by default. `Gray comatrix` scales the image to eight gray-levels if I is an intensity image.

3. Shape Feature

Lloyd's algorithm is used for finding the shape of the crop. It starts by partitioning the input points into k initial sets, either at random or using some heuristic data. It then calculates the mean point, or centroid, of each set. It constructs a new partition by associating each point with the closest centroid. Then the centroids are recalculated for the new clusters, and algorithm repeated by alternate application of these two steps until convergence, which is

obtained when the points no longer switch clusters (or alternatively centroids are no longer changed). Lloyd's algorithm and k-means are often used synonymously, but in reality Lloyd's algorithm is a heuristic for solving the k-means problem, as with certain combinations of starting points and centroids, Lloyd's algorithm can in fact converge to the wrong answer. Other variations exist, but Lloyd's algorithm has remained popular, because it converges extremely quickly in practice. In terms of performance the algorithm is not guaranteed to return a global optimum. The quality of the final solution depends largely on the initial set of clusters, and may, in practice, be much poorer than the global optimum.

C. Feature Extraction

Local Directional Pattern (LDP)

LDP is a gray-scale texture pattern which characterizes the spatial structure of a local image texture. A LDP operator computes the edge response values in all eight directions at each pixel position and generates a code from the relative strength magnitude. Since the edge responses are more illumination and noise insensitive than intensity values, the resultant LDP feature describes the local primitives including different types of curves, corners, and junctions, more stably and retains more information. Given a central pixel in the image, the eight directional edge response values { }, 0, 1... 7 i m i = are computed by Kirsch masks i M in eight different orientations centered on its position. The masks are shown in below figure.

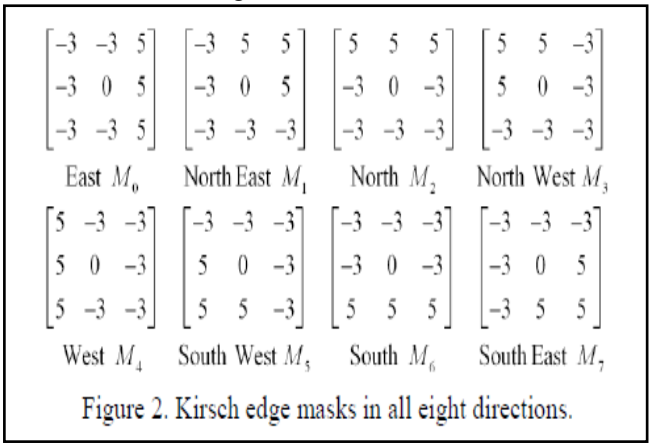


Figure 2. Kirsch edge masks in all eight directions.

The response values are not equally important in all directions. The presence of a corner or edge causes high response values in some directions. Therefore, we are interested in the k most prominent directions to generate the LDP. Here, the top k directional bit responses i b are set to 1. The remaining (8-k) bits of the 8-bit LDP pattern are set to 0. Finally, the LDP code is derived using equation 1.

$$LDP_k = \sum_{i=0}^{7} b_i(m_i - m_k) \times 2^i$$

$$b_i(a) = \begin{cases} 1 & a \geq 0 \\ 0 & a < 0 \end{cases}$$

Where, mkis the k-th most significant directional response. Since edge responses are more stable than intensity values, LDP pattern provides the same pattern value even presence of noise and non-monotonic illumination changes. After computing the LDP code for each pixel (r , c) , the input image I of size M × N is represented by a LDP histogram H using equation 3. The resultant histogram H is the LDP descriptor of that image.

D. NN Classifier

The K-means algorithm is an iterative technique that is used to partition an image into K clusters. The basic algorithm is:

1. Pick K cluster centers, either randomly or based on some heuristic
2. Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster center.
3. Re-compute the cluster centers by averaging all of the pixels in the cluster
4. Repeat steps 2 and 3 until convergence is attained (e.g. no pixels change clusters)

In this case, distance is the squared or absolute difference between a pixel and a cluster center. The difference is typically based on pixel color, intensity, texture, and location, or a weighted combination of these factors. K can be selected manually, randomly, or by a heuristic.

VI. Conclusion

"Agriculture is the backbone of Indian economy". So Agro Consultant application looks for ways to increase productivity in efficient manner possible. Databases also facilitate outbreak monitoring and can send early warning. It sends warnings specific to locations. It is a user friendly application with simple use interface so that farmer can access it easily.

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